

MAMMOMAT 300

SP

Service Instructions

Register 5

RX B7-120.061.01.05.02

Replaces: RX B7-120.061.01.04.02

english

10.96

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Required documents

- Wiring diagram MAMMOMAT 300 RX B7-120.051.01... (X041E)
- Installation and setting instructions RX B7-120.033.01...
- Function description RX B7-120.041.01...

Required measuring instruments and appliances

- Densitometer - Sensitometer
- Oscilloscope, e.g. TEKTRONIX 314
- Digital multimeter incl. mAs- meter
- Service PC with connecting cable
- Service cable 63 82 746
- Plexiglass plates
(three plates measuring 150 mm x 150 mm x 20 mm
and one plate measuring 150 mm x 150 mm x 10 mm,
part no. 85 49 438 and 97 88 423 respectively)
- Digital voltmeter (Fluke type 8060A, part no. 97 02 101 Y4290, or
Fluke type 87, part no. 97 03 976 Y4290)

Required tools

- Common tool kit
- Scale 0 - 25 kg (in steps of 0.1 kg)
- Electrical screwdriver with bit set (recommended)

Protective measures

Checks which must be performed under X-ray radiation are marked with the radiation warning symbol .

Location of components

See wiring diagram X041E for MAMMOMAT 300.

Safety

Warning!

When reassembling any part of the equipment, all contact washers must be used as in the original assembly. Screws must be securely tightened and the contact washers must be functional to establish protective ground connections and to eliminate interferences.

Protective strips for the metal curtain

The edges of the metal curtain are very sharp. Protective strips must therefore always be applied onto the edges of the metal curtain during service and maintenance work in the stand, see Fig. 1

Caution: *Should a vertical adjustment of the swivel-arm system be required during the service procedures, the protective strips must be removed from the metal curtain and then put back again after completed adjustment. Also, do not forget to remove the protective strips before installing the front covers.*

Holders for storing the protective stripes when not in use, are provided on both sides of the metal curtain, see Fig. 2.

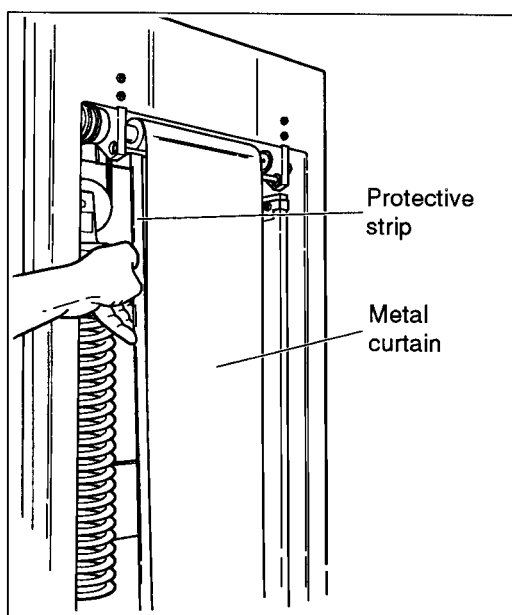


Fig. 1

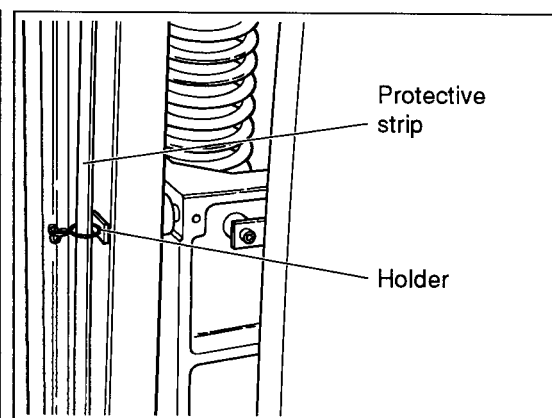


Fig. 2

Stand, removal of covers

Right side cover

(for service on/exchange of circuit boards D801 and D802, see Fig. 2)

- Loosen the screw (3/Fig. 1) at the top of the stand.
- Pry loose the plastic strip (see 4/Fig. 1), using a screwdriver or similar tool.
- Loosen the screws now accessible and remove the cover (5/Fig. 1).

Left side cover

(6/Fig. 1, for adjustment/exchange of S881, S883, S884)

- Loosen the screw (7/Fig. 1) and proceed as for the right side cover.

Rear cover

(removal of the rear cover is only possible if side covers are removed; for service on/exchange of S882, lift motor, rotary motion motor, angle detector D806)

- Loosen the two screws (1/Fig. 1) at the top of the stand.
- Remove the cover by lifting it up (2/Fig. 1).

Front covers

Warning! The metal curtain (10/Fig. 1) is very sharp. Therefore, be extremely careful when removing/reassembling the front covers. After removing the front covers, fit the protective strips onto the edges of the metal curtain, see page 1-2.

- To remove the two front covers (8/Fig. 1), loosen the screws (9/Fig. 1) at the top of the stand and, if the side covers have not already been removed, also the screws behind the plastic strips (4/Fig. 1).

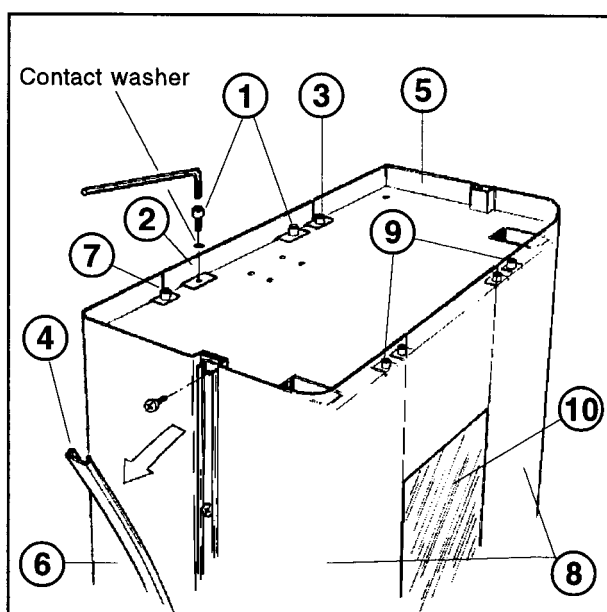


Fig. 1

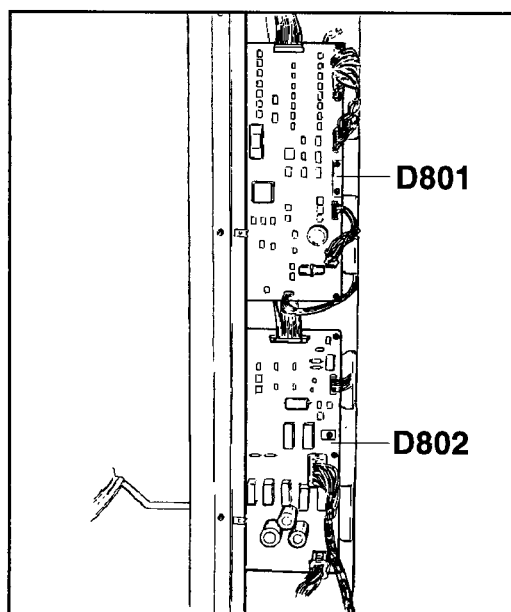


Fig. 2

Swivel-arm covers

(for service on/exchange of X-ray tube, collimator, circuit board D805/D807)

- Loosen the two screws (1/Fig. 3) and remove the front cover.
- Loosen the six screws (2/Fig. 3) of the cover half you want to remove.
- Before removing the cover half, disconnect plug X807 and the ground wire, see Fig. 4.

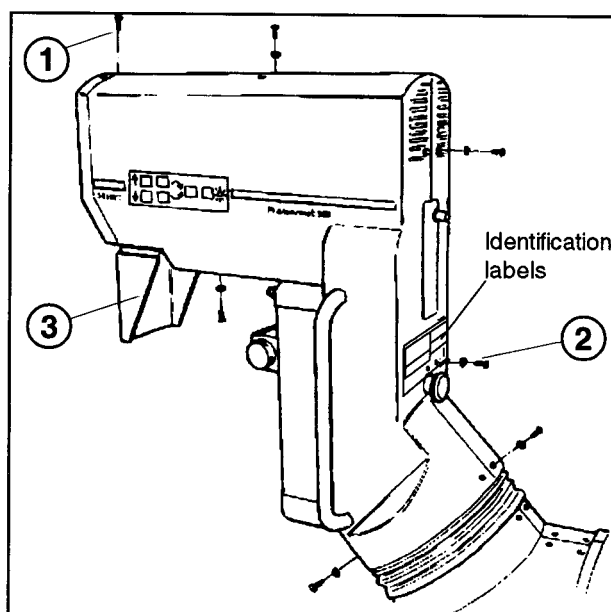


Fig. 3

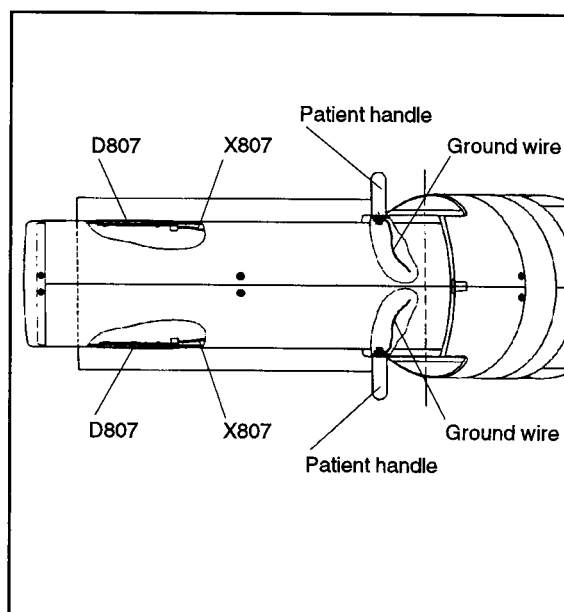


Fig. 4

Face shield

- To remove the face shield, just bend the two sides slightly outwards and pull it off the holder (3/Fig.3).

Support-arm cover

- To adjust or exchange the rotation potentiometer R803, loosen the six screws (2/Fig. 5), unplug X808 and remove the right part of the support-arm cover (1/Fig. 5)

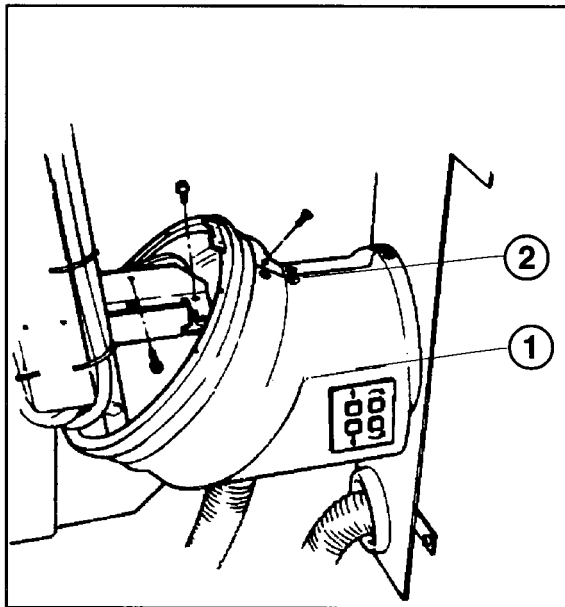


Fig. 5

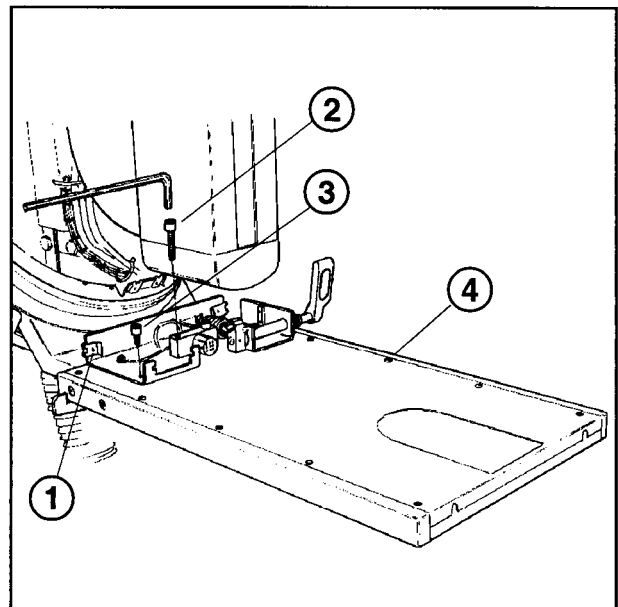


Fig. 6

Base-plate cover

(for service on/exchange of HSE double detector)

- Loosen the two screws (1/Fig. 6) to remove the cover over the table-locking device.
- Loosen the four screws (2 and 3/Fig.6) to remove the table-locking device from the base plate.
- Loosen the ten screws (4/Fig. 6) and remove the base-plate cover. The HSE double detector is now accessible.

Bucky-table cover

(for service on the grid device)

- Loosen the four long screws on the top side (1/Fig. 7) and the four short screws at the front (2/Fig. 7). Remove cover. The grid device is now accessible.

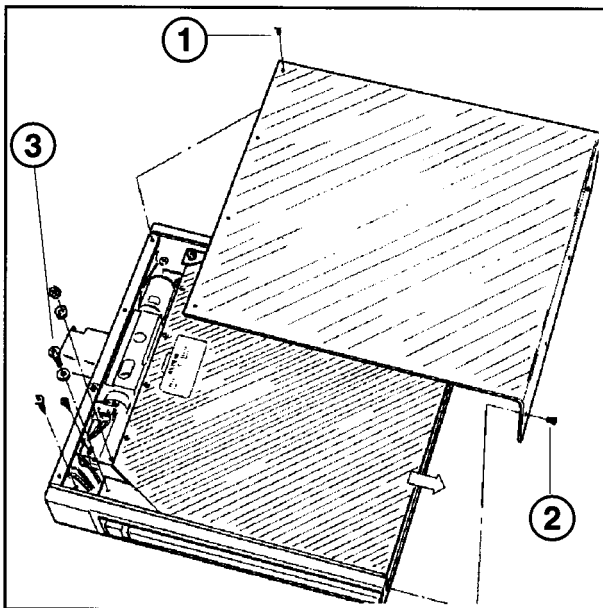


Fig. 7

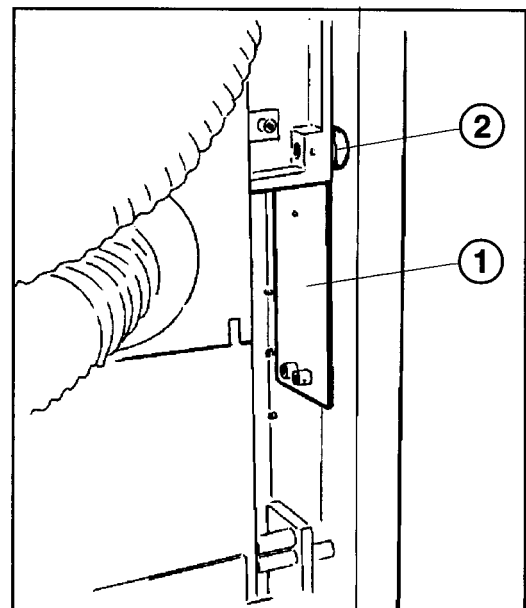


Fig. 8

Transport safeguard

(for service on/exchange of lift motor, driving belt)

- Lower the carriage and lock the carriage by means of the transport safeguard (1/Fig.8).

Note: Fit the shaft of the bearing (2/Fig. 8) into the recess of the transport safeguard.

Front cover

(for service on/exchange of generator components)

- Pry loose the plastic strips (1/Fig. 9) on both sides, using a screwdriver or similar tool.
- Loosen the sixteen screws now accessible (eight on either side) and remove the front cover (2/Fig. 9).

Note: Pay special attention to the contact washers (there are four contact washers on either side). These washers are needed again when reassembling the front cover, to establish protective ground connection.

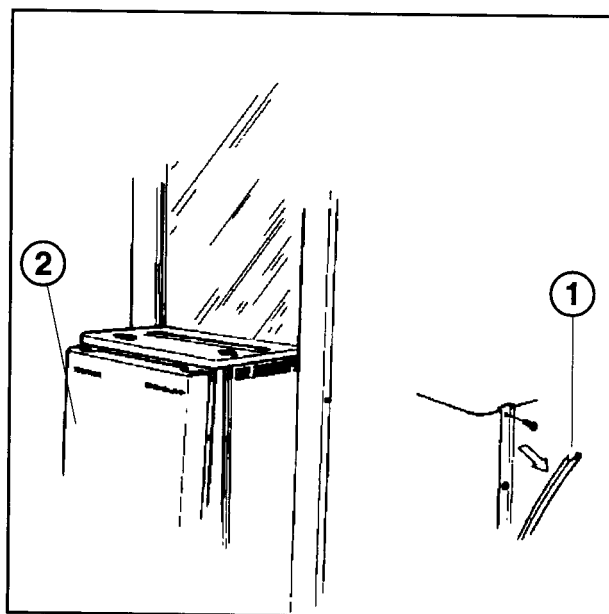


Fig. 9

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Removal

- Remove the swivel-arm covers, see page 2 - 2.
- Disconnect plugs X872 and X873 (1 and 2/Fig. 1) on circuit board D805.
- Disconnect plug X874 located behind the compression unit.
- Disconnect ground wires (1/Fig. 2).
- Loosen the three fixing screws (2/Fig. 2) and remove compression unit.

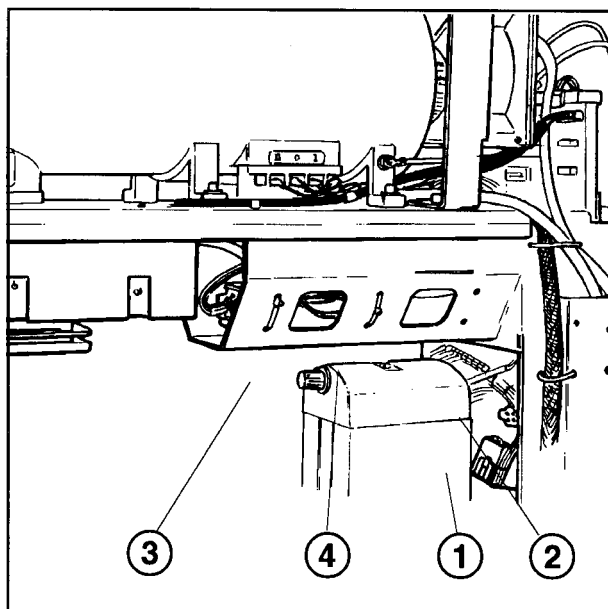


Fig. 1

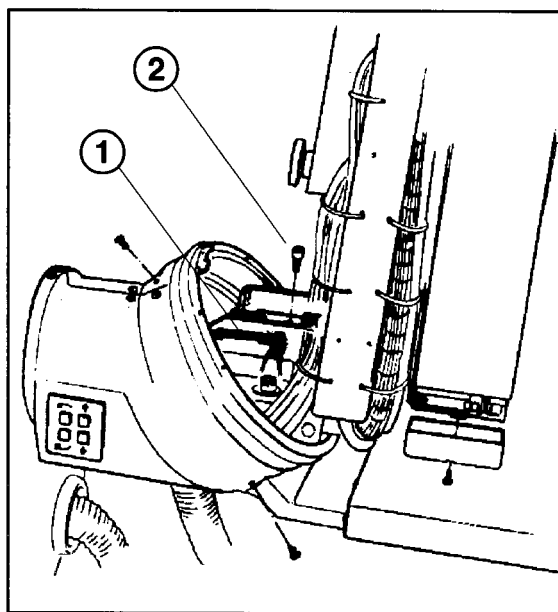


Fig. 2

Exchanging the force-presetting potentiometer R861

- Remove the potentiometer knob (3/Fig. 1). The knob is held by a screw, which is accessible after the front cap on the knob has been pried loose.
- Disengage the snap lock (4/Fig. 1) and remove the upper cover.
- Exchange potentiometer.
- Recalibrate potentiometer check and preset force acc. to 4 - 30, 4 - 31.

Exchanging the MIN (S862) - MAX (S861) force-limit switch

Note: Before exchanging the above-mentioned switches, mark their original position to ensure as correct positioning of the new switch(es) as possible.

- Note the value for Force = 200 N, see page 4 - 30.
- Program Force = 200 N to 3FF and place the scale on the object table.
- Compress to 240 N with the motor and a normal compression plate. **Do not decompress!** If necessary, back to 0 N and repeat.
- Adjust S861 so that it just opens at 240 N (230 - 250 N).
- Reprogram Force = 200 N to its original value.
- Decompress to the top, run the compression plate downwards approx. 50 mm (the compression plate must not touch the object table).
- Place a 3 kg weight in the compression plate.
- Adjust S862 so that it opens (2 - 5 kg).
- Recheck the calibration of 0 N and 200 N with the service PC (see page 4 - 30).

Exchanging the compression unit

- Remove the compression unit as described on page 3 - 1.
- Install the new compression unit.

Note: Before tightening the fixing screws, the compression unit must be oriented to the object table as follows:

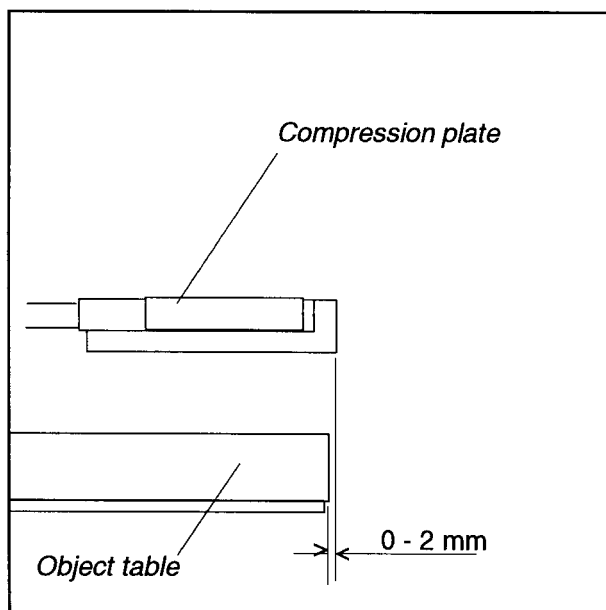


Fig. 3

1. Attach an object table and pertaining compression plate.
 2. Make sure that the compression plate aligns with the object table and that it protrudes 0 - 2 mm over the front edge of the object table, see Fig. 3 (ensure that the compression plate is fully pushed in to bottom position).
- Tighten the fixing screws.
 - Calibrate all values in the "Stand config" - Calibrate compression menu. See page 4 - 30 and 4 - 31.

Removing the collimator unit

- Remove the swivel-arm covers, see page 2 - 2.
- Cut cable tie (1/Fig. 4) and disconnect plug X894 (2/Fig. 4).

Note: Hold the collimator unit while loosening the screws.

- Loosen the four screws (3/Fig. 4) and remove the collimator unit (4/Fig. 4).

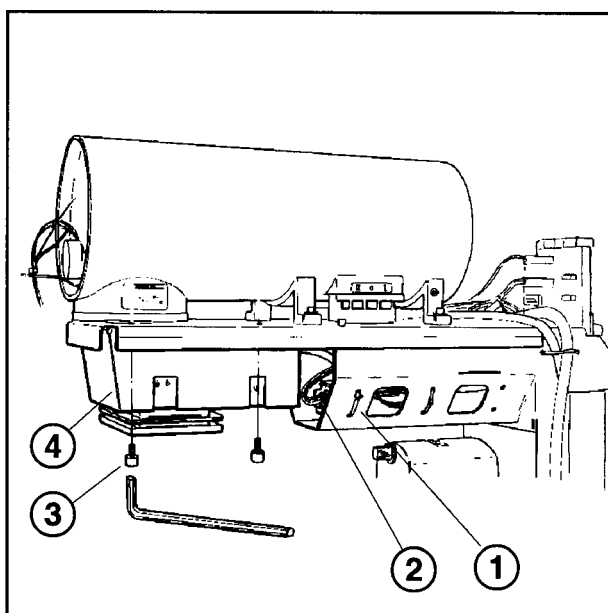


Fig. 4

Exchanging the collimator unit

Note: After exchanging the whole collimator unit, it is necessary to readjust the radiation field and check the light field (see page 8 - 3 in this manual and chapter "Checking the radiation field limitation" in the Installation and Start-Up Instructions for MAMMOMAT 300).
Exchange label on the right side cover of the stand, see Operating Instructions.

Exchanging the collimator lamp

- Remove the swivel-arm covers, see page 2 - 2.
- Remove the rear plate from the collimator unit (1/Fig. 5).
- Loosen the locking screws a quarter of a turn (2/Fig. 5) and swing down the lamp holder to exchange the lamp (3/Fig. 5).

Note: Do not touch the lamp with bare fingers.

- Check the light field.

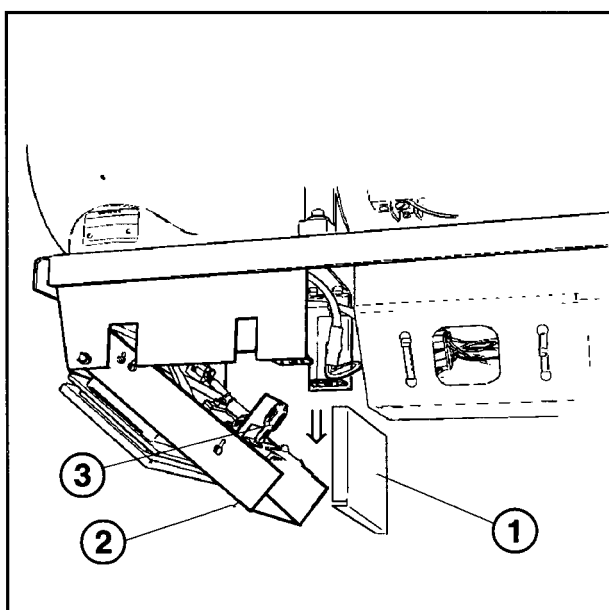


Fig. 5

Exchanging CPU board D801

- If possible, read out programmed values or save configuration file.
- Remove right side cover and right front cover, see page 2 - 1.
- Remove the screw profile (1/Fig. 6)
- Disconnect all plugs on CPU board D801.
- Remove firmware I9 (2/Fig. 6).
- Remove the seven nuts holding the board.
- Exchange board, reinstall firmware and reconfigure (see from 4 - 28).

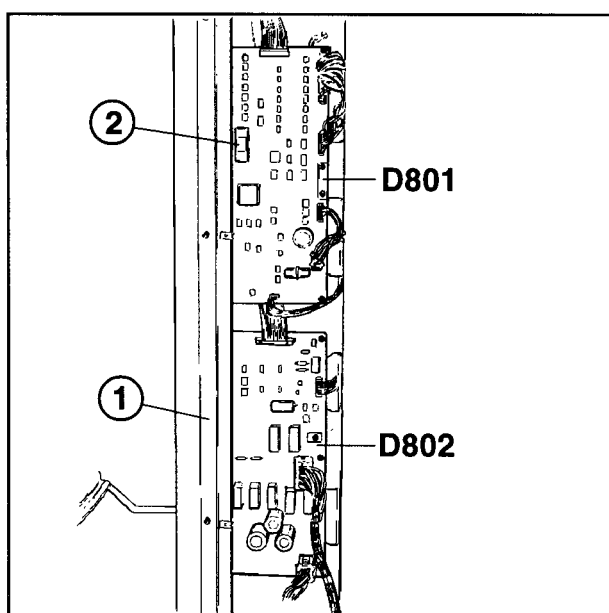


Fig. 6

Exchanging motor-control board D802

- Remove right side cover and right front cover, see page 2 - 1.
- Remove the screw profile (1/Fig. 6)
- Disconnect all plugs on motor-control board D802.
- Remove the six nuts holding the board.
- Exchange board.

Exchanging display including board D803

- Remove the two screws at the bottom (1/Fig. 7).
- Display including circuit board swings out.
- Disconnect plug X801 and exchange complete unit.

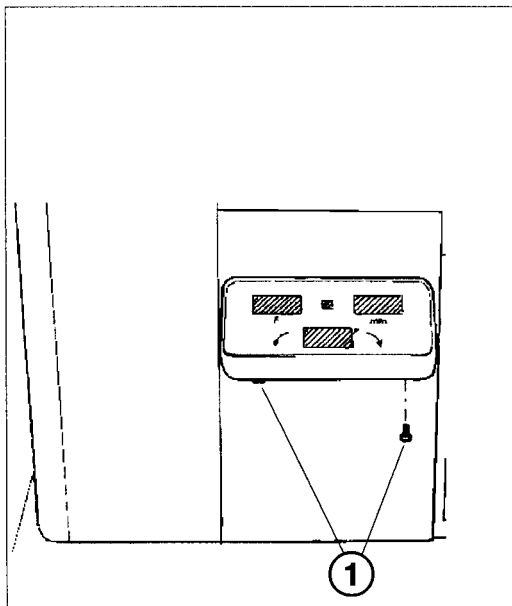


Fig. 7

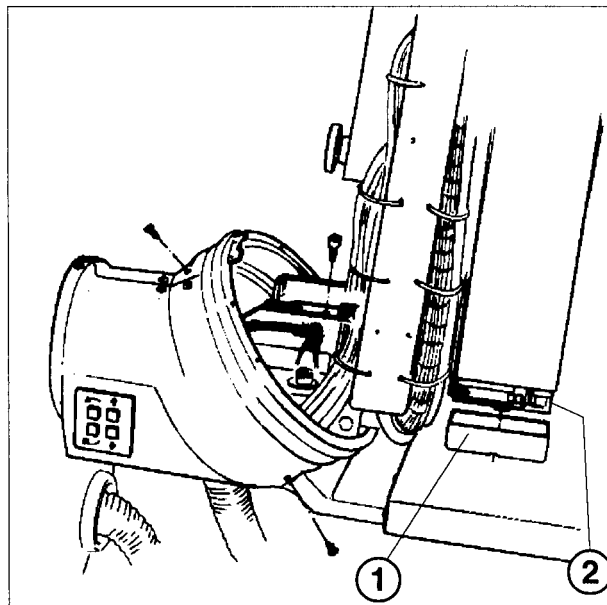


Fig. 8

Exchanging compression-force board D804

- Disengage the snap lock and remove the bottom cover (1/Fig. 8) from the compression unit.
- Disconnect plugs on the board and exchange board (2/Fig. 8).
- Adjust potentiometers R8 and R9 as follows:
 - Attach a normal compression plate.
 - Decompress to the top, run the compression plate downwards approx. 50 mm.
 - Connect the digital multimeter to X843, pin 5(+) (comp_force), and pin 4(-) (0).
 - Adjust R9 (offset) for 0 ± 30 mV. (Note that comp_force cannot be set to 0 V with respect to 0 VA.)
 - Move the voltmeter lead from pin 5 to pin 3 (0 VA).
 - Compress to 200 N.
 - Adjust R8 (gain) for $3.5 \text{ V} \pm 0.1 \text{ V}$.
- Calibrate 0 N and 200 N with the service PC (see page 4 - 30).

Exchanging swivel-arm board D805

- Remove the swivel-arm covers, see page 2 - 2.
- Remove the two screws (1/Fig. 9) under the presetting angle potentiometer after removing the potentiometer holder (5/Fig. 9)

Note: *Be careful not to drop any washers into the machinery.*

- Remove the two screws (2/Fig. 9) above the emergency stop button (3/Fig. 9).
- Disconnect all plugs from the D805 and separate the emergency stop button from the switch (snap connection).
- Loosen the eight screws (4/Fig. 8) from the holder.

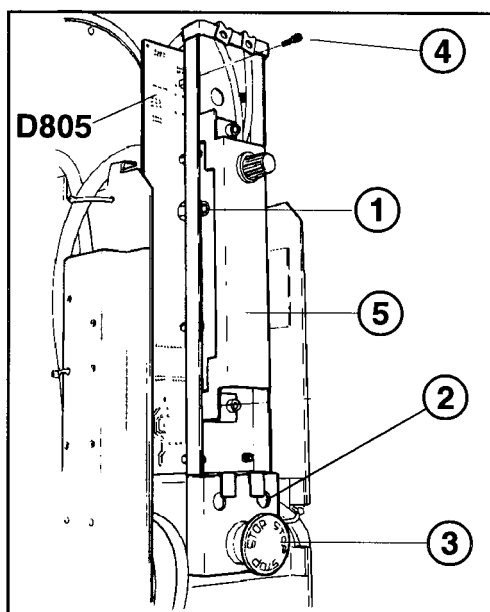


Fig. 9

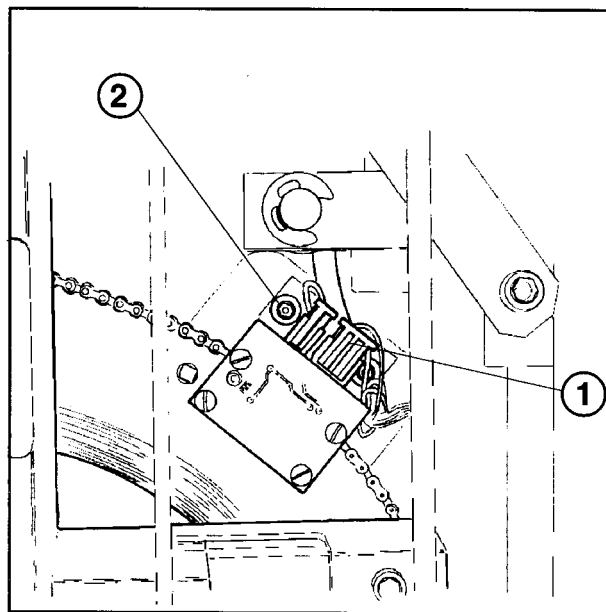


Fig. 10

Exchanging angle-detector assembly incl. board D806

- Remove the side covers and the rear cover from the stand, see page 2 - 1.
- Move the lifting carriage to upper position.
- Disconnect plug X861 (1/Fig. 10) on circuit board D806.
- Remove the two screws (2/Fig. 10) to exchange the assembly.

Exchanging the lifting carriage motor

- Remove side covers and rear cover from the stand, see page 2 - 1.
- Lock the lifting carriage by means of the transport safeguard, see page 2 - 4.
- Open the driving belt (1/Fig. 13).
- Loosen the three screws (1/Fig. 11) to remove the motor (1/Fig. 12).

Note: Tighten the belt carefully after exchanging the motor.

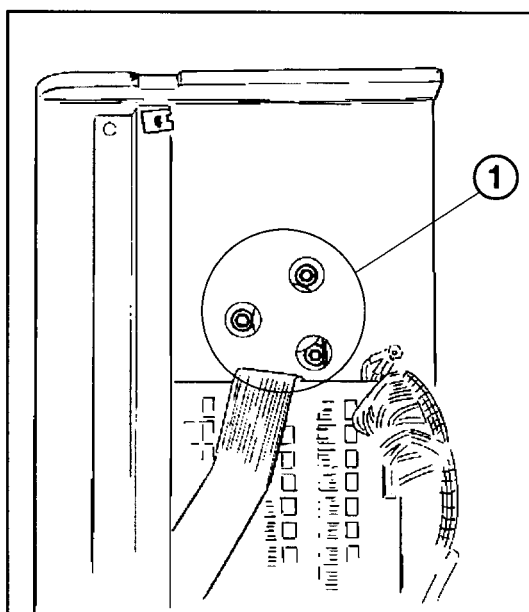


Fig. 11

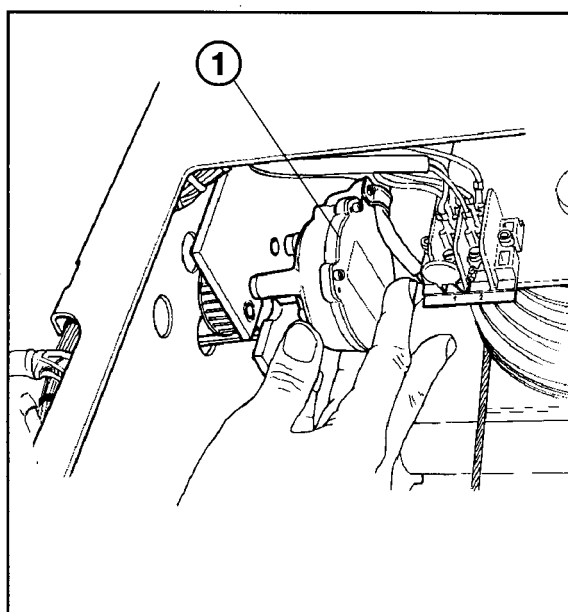


Fig. 12

Exchanging the rotary motion motor

- Remove all covers from the stand, see page 2 - 1.

Note: Hold the chain while dismounting the motor and fix it in upper position, using a cable tie.

- Loosen the three screws (2/Fig. 13), disconnect plug and remove the motor.
- Exchange motor and tighten the chain carefully.

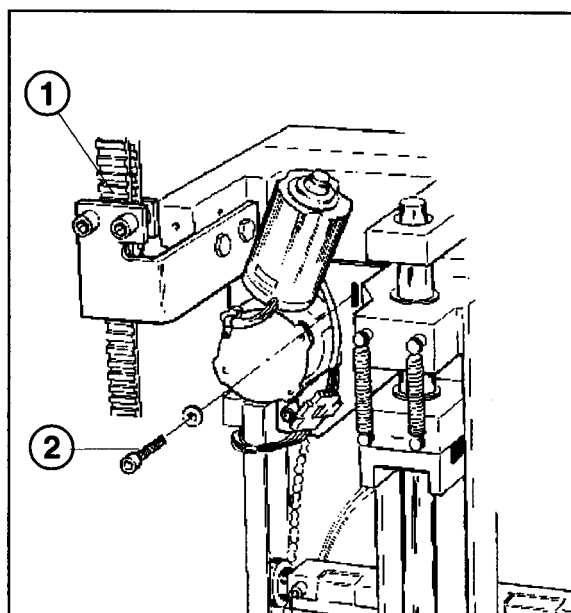


Fig. 13

Detector exchange

- Remove the table base-plate cover, see page 2 - 3.
- Disconnect plug.
- Exchange the HSE double detector.

Note: *Special attention should be paid to the detector insulation.*

- Recalibrate sensitivity, see page 4 - 2.

Replacing cassette switch S2

- Remove the carbon-fibre plate cover, see page 2 - 3.
- Due to different wiring in the tables, it might be necessary to remove the grid device. To do that, loosen the four screws (3/Fig. 7, page 2 - 4) and remove the grid device. For readjustment, mark the original position of the grid device.
- **24 cm x 30 cm object table:**
Loosen six nuts from below and withdraw bottom plate to the left (pay special attention to the grounding spring).
- **18 cm x 24 cm object table:**
Loosen four screws (two on either side) and withdraw bottom plate (double-sided tape is used for fixing the plastic plates).
- Replace switch.

Replacing the rotary motion chain

- Remove rotary motion motor, see page 3 - 8.
- Find the chain connecting link and open chain.
- Replace chain and tighten carefully.

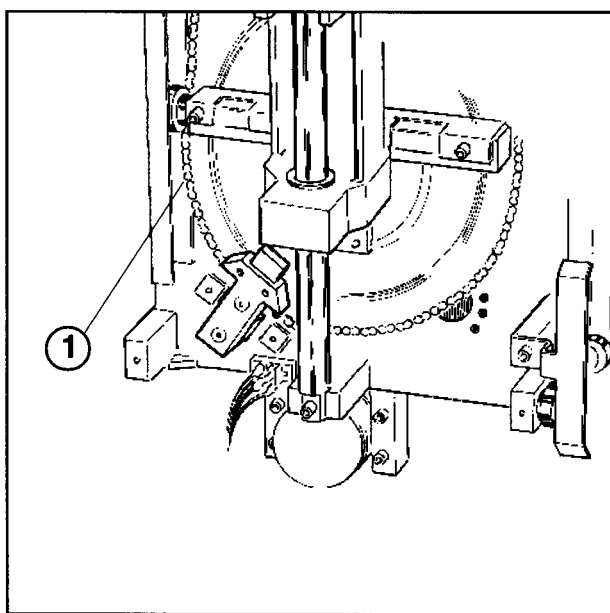
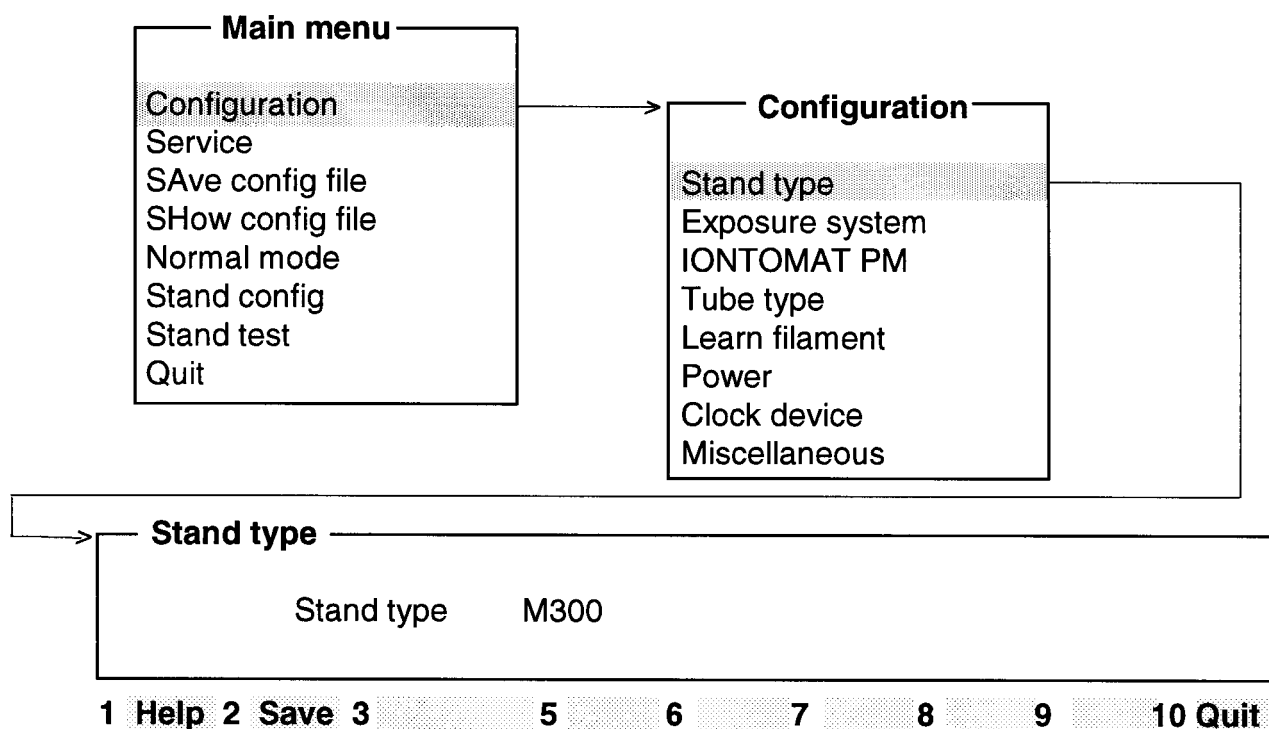


Fig. 14

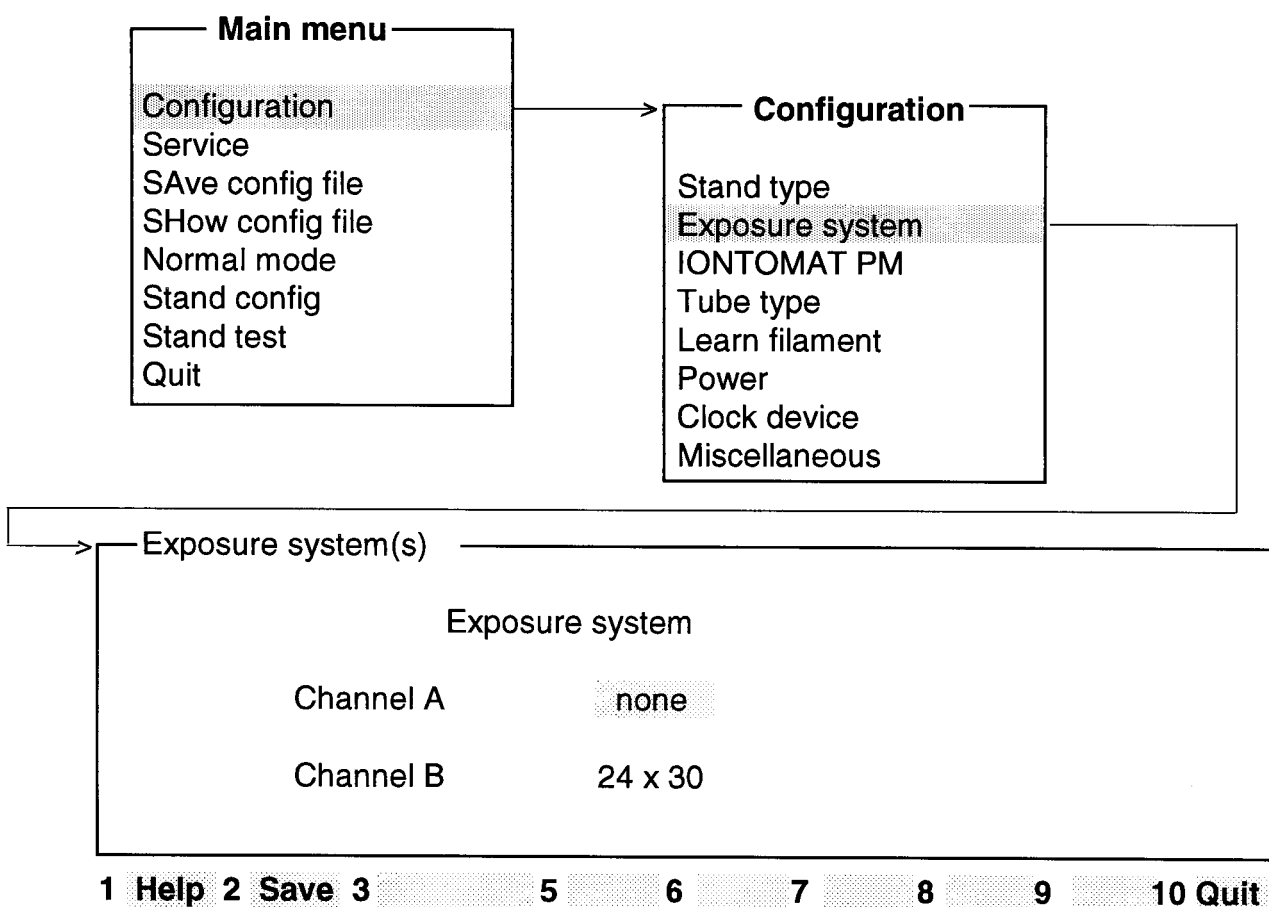
Replacing the lifting carriage driving belt

- Remove right side cover and rear cover, see page 2 - 1.
- Lock the lifting carriage, using the transport safe guard, see page 2 - 4.
- Open belt (1/Fig. 12)
- Replace belt and tighten it carefully.

Stand type, exposure system



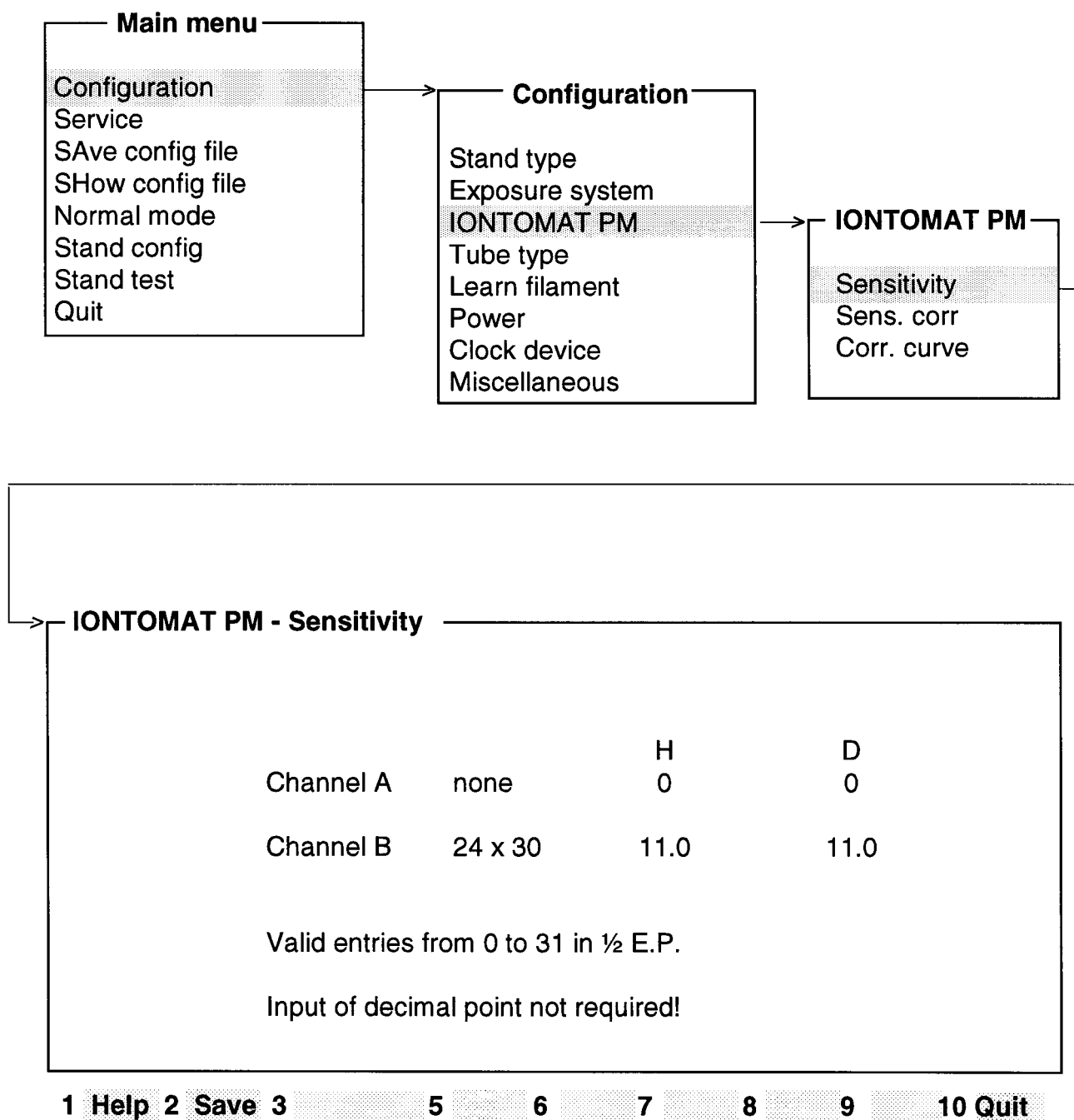
Indicates type of generator and control panel. Correct designation is M300.



Indicates which channel is activated in the IONTOMAT.

Channel A is not used with M300 and shall therefore always be set to none.

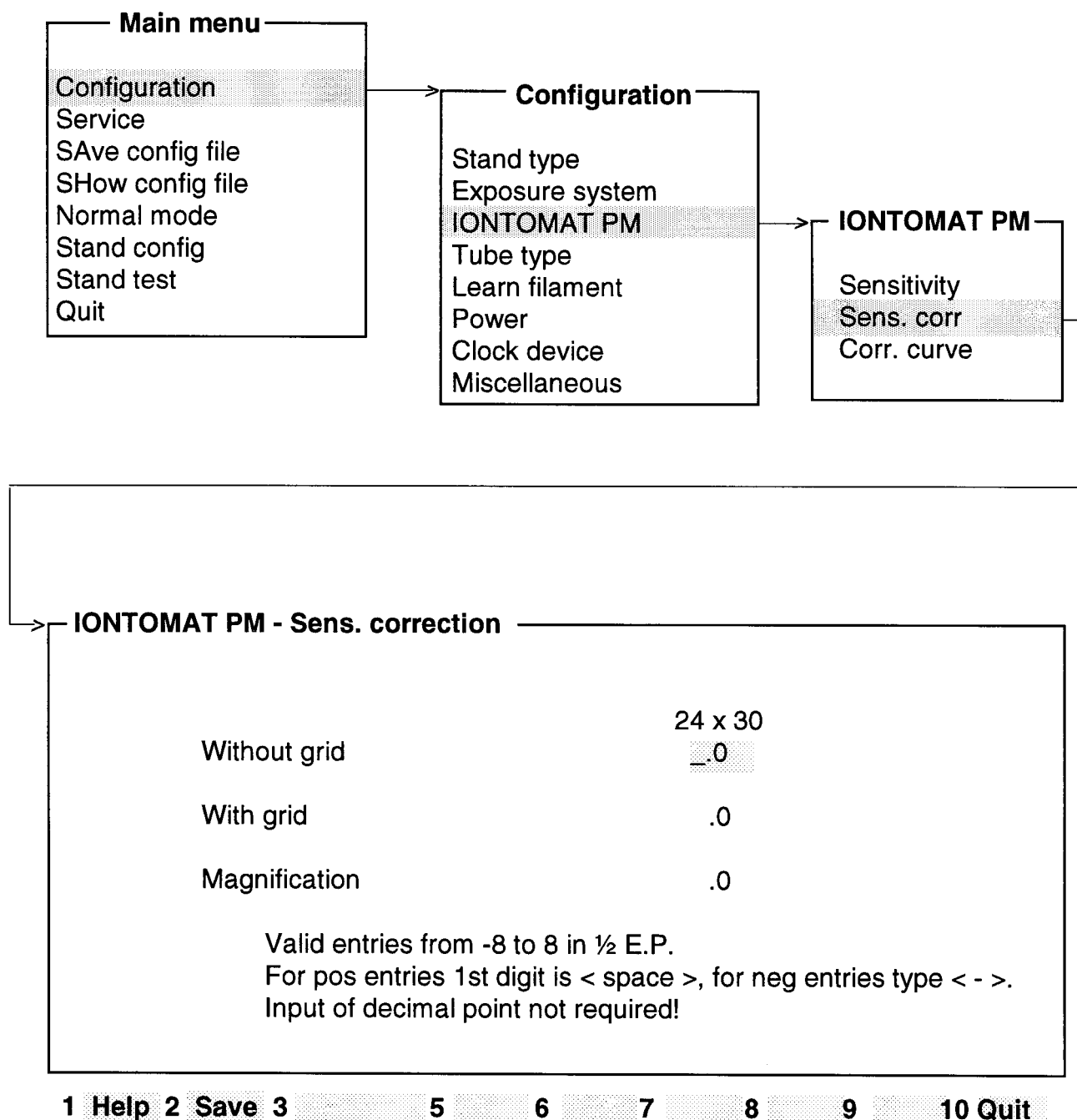
Channel B is set to 24 x 30 by the firmware ("none" or "18 x 24" is not allowed with channel B).



Indicates the sensitivity of the IONTOMAT channel for contact  (H) and magnification  (D) object table.

Values from 0 to 31 can be entered in ½ exposure points.

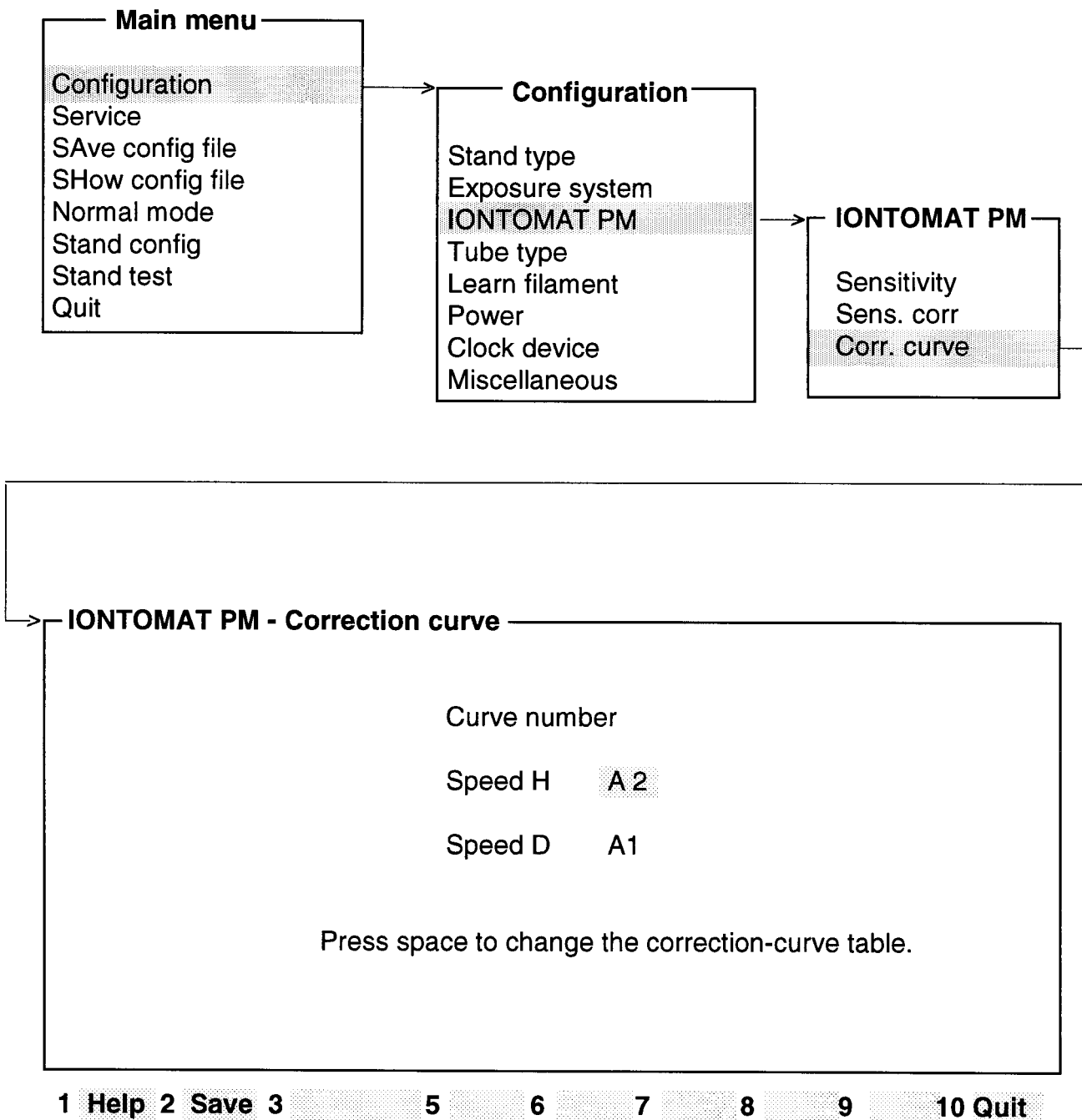
Channel A is not used, the sensitivity is therefore set to 0.



Indicates the sensitivity correction for different types of object tables.

The position "without grid" applies to tables with as well as without grid.

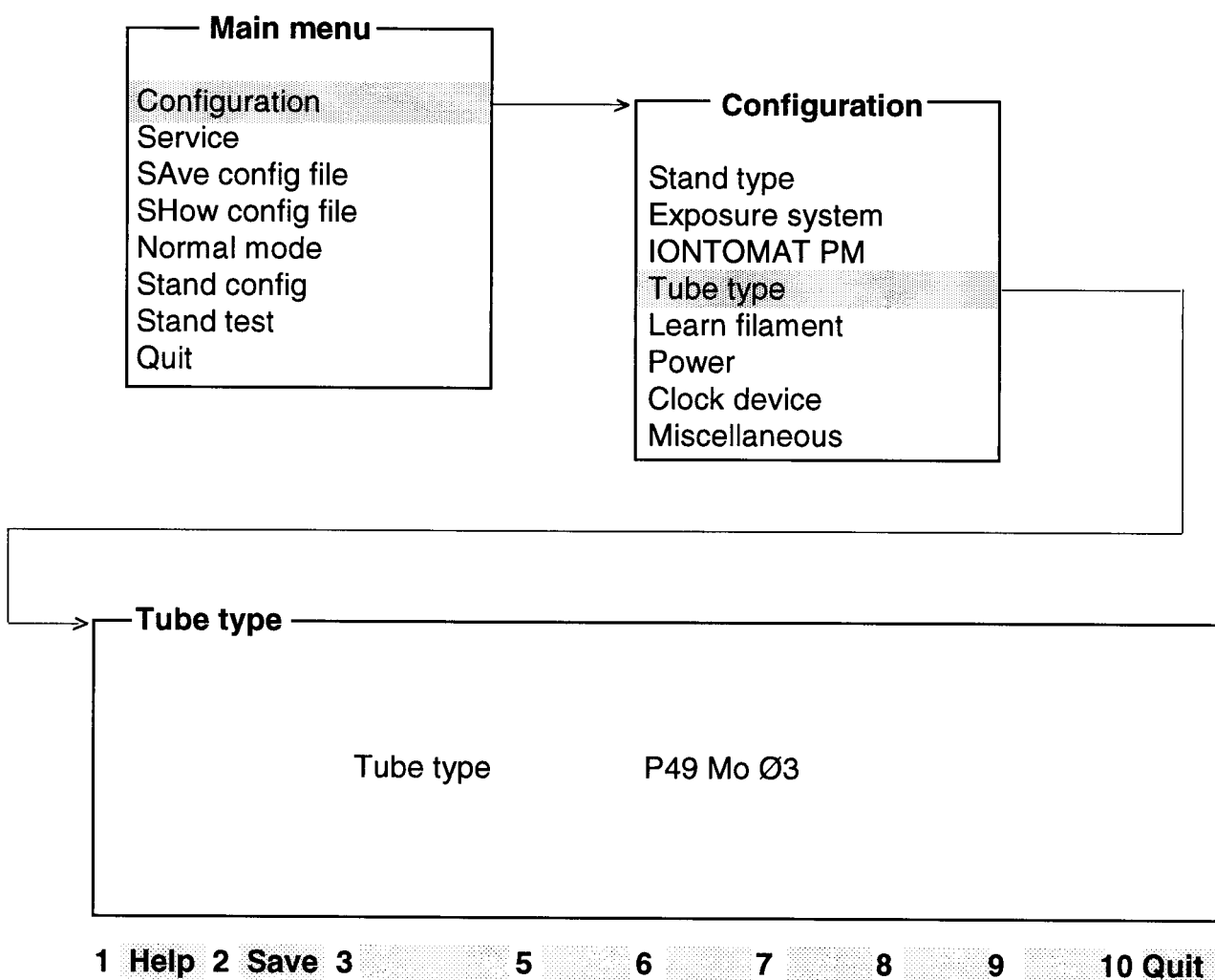
Factory-set to "0", "0", "0".



Indicates which correction curve shall be used for contact  (H) and magnification  (D) object table. Values shown as delivered.

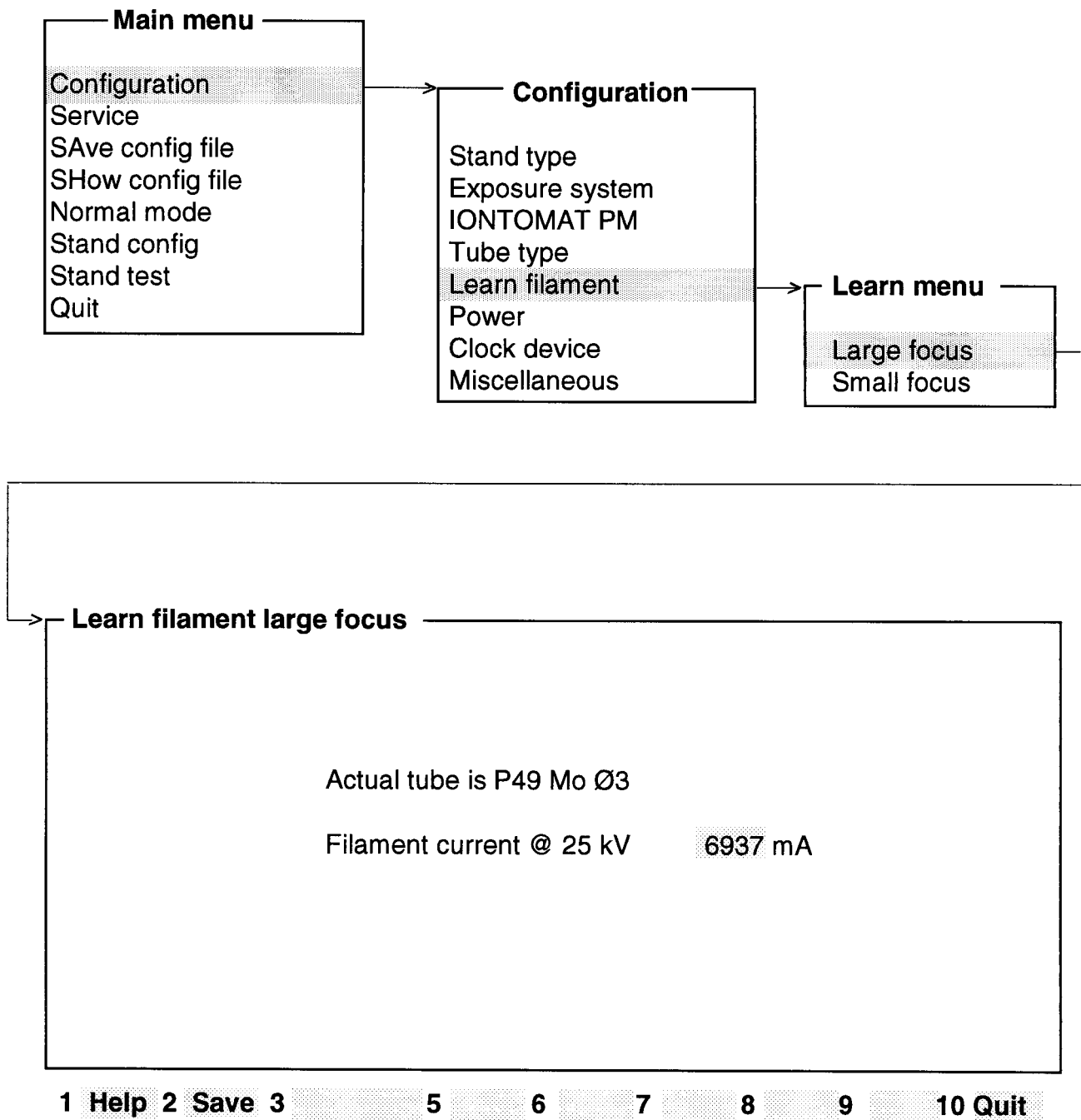
For further information, please refer to the installation manual, chapter "Start-up and functional test of the IONTOMAT PM".

Tube type



Indicates the type of X-ray tube used in the system.

For M300, P49 Mo Ø3 shall be entered.

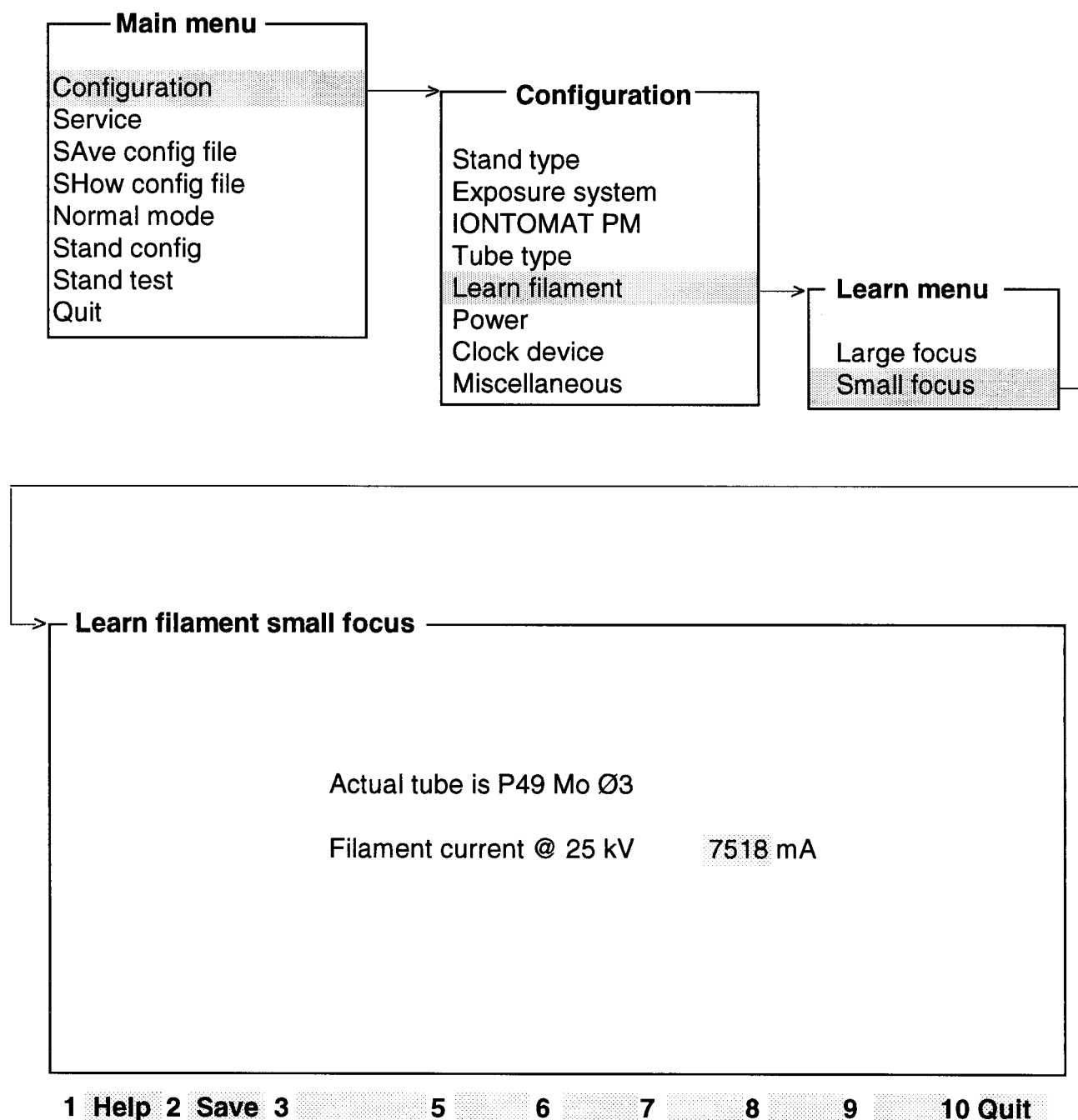


Indicates the adapted filament current for large focus. Adaption exposures for the filament current are also made in this menu.

Pressing F2 sets the exposure parameters on the control panel, and subsequently pressing Alt-F6 starts the exposure. Repeat this procedure until the tube-current deviation is within $\pm 5\%$.

If the tube has been replaced, program the filament-current value stated in the test certificate.

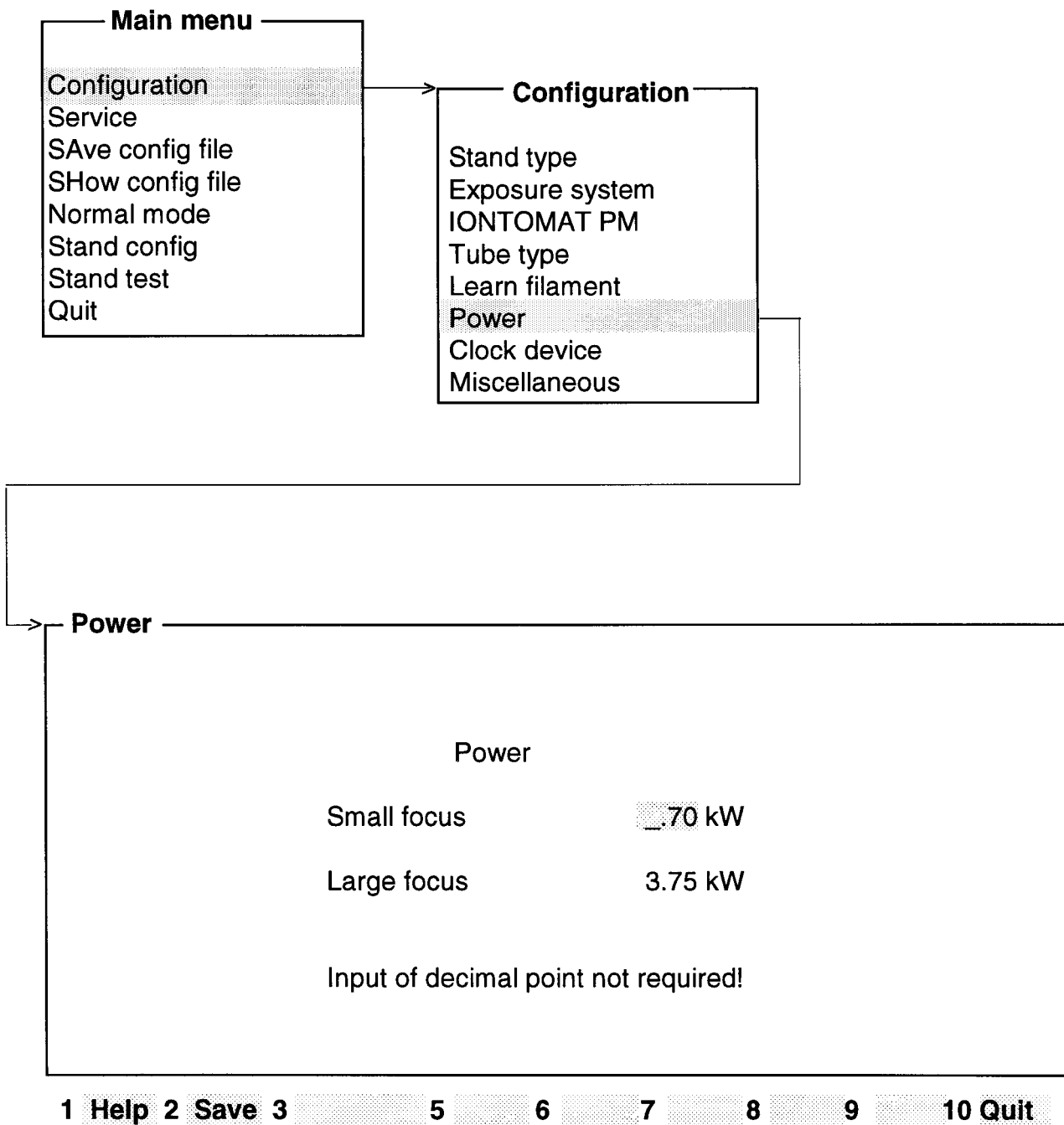
Learn filament, small focus



Indicates the adapted filament current for small focus. Adaption exposures for the filament current are also made in this menu.

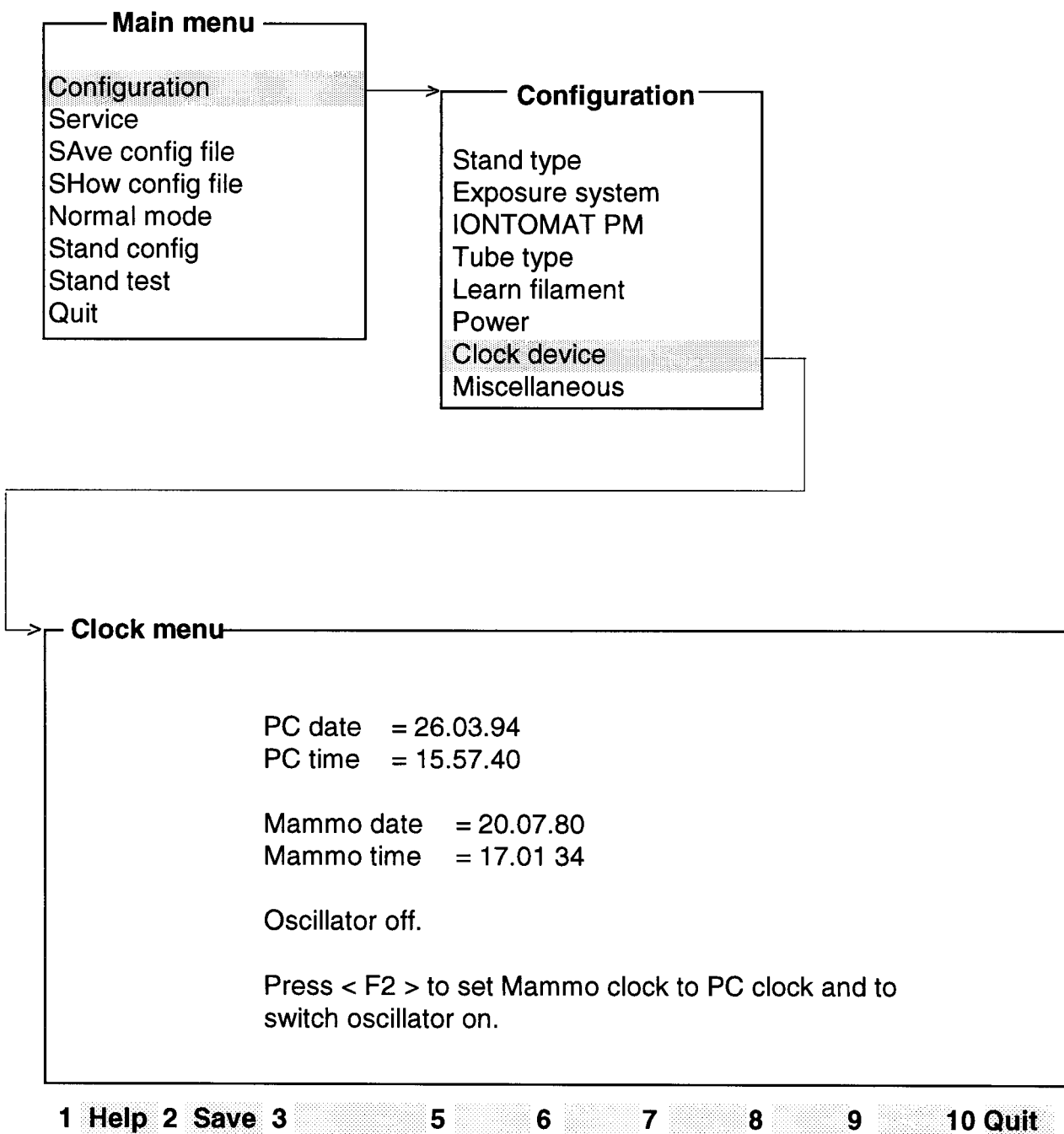
Pressing F2 sets the exposure parameters on the control panel, and subsequently pressing Alt-F6 starts the exposure. Repeat this procedure until the tube-current deviation is within $\pm 5\%$.

If the tube has been replaced, program the filament-current value stated in the test certificate.



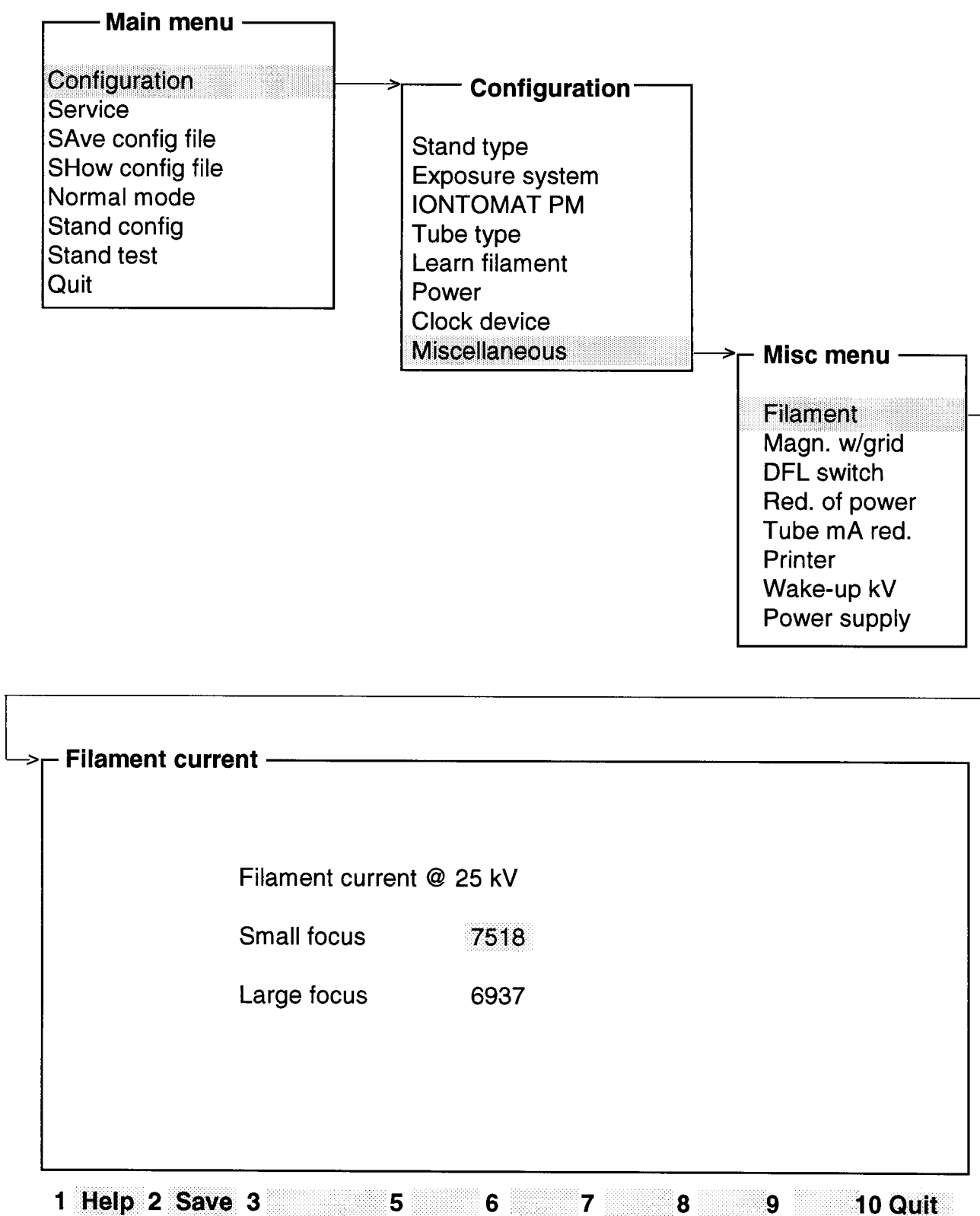
Indicates the maximum power for large and small focus respectively.
The values programmed must not exceed the values stated above.

Clock device

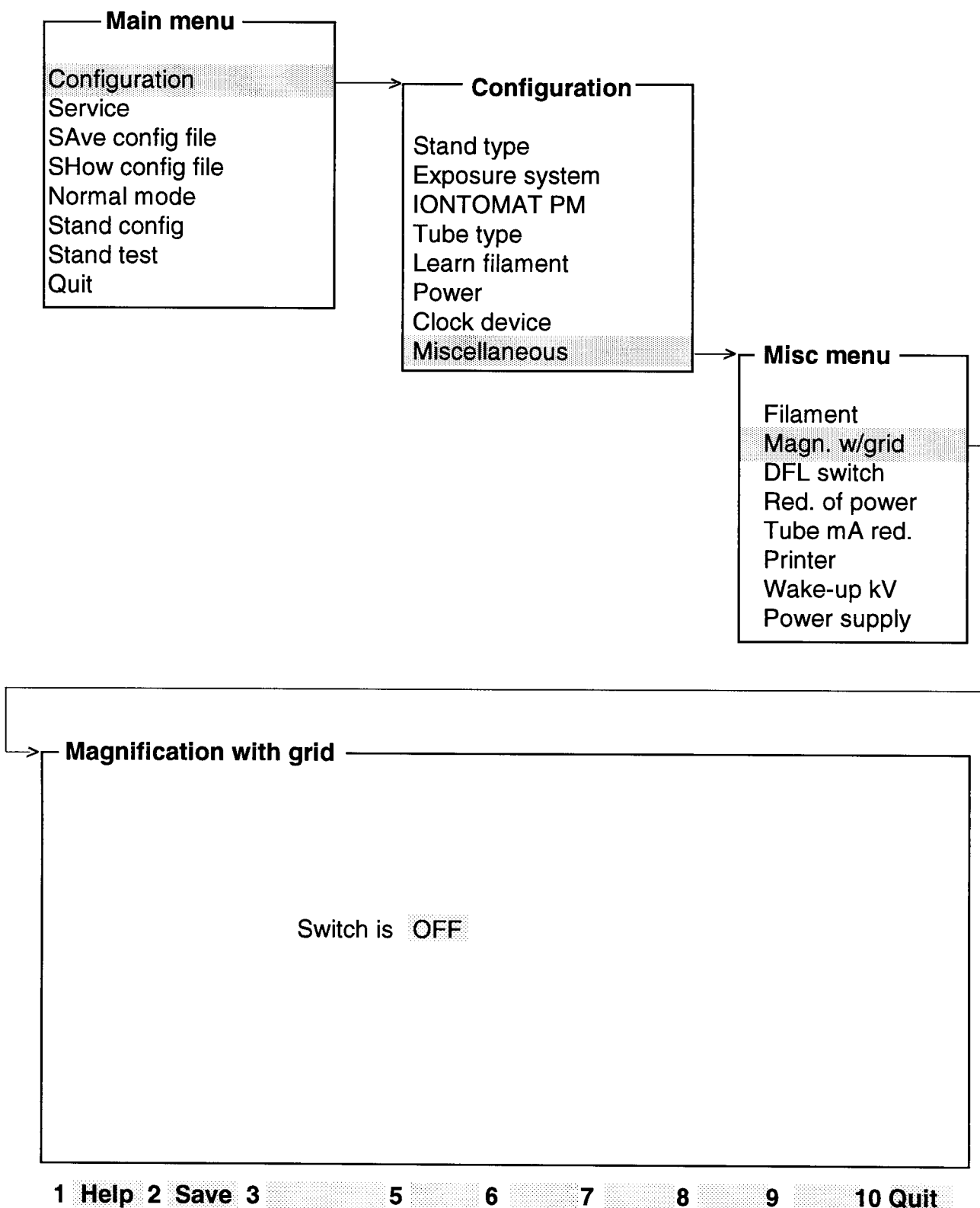


Indicates date and time.

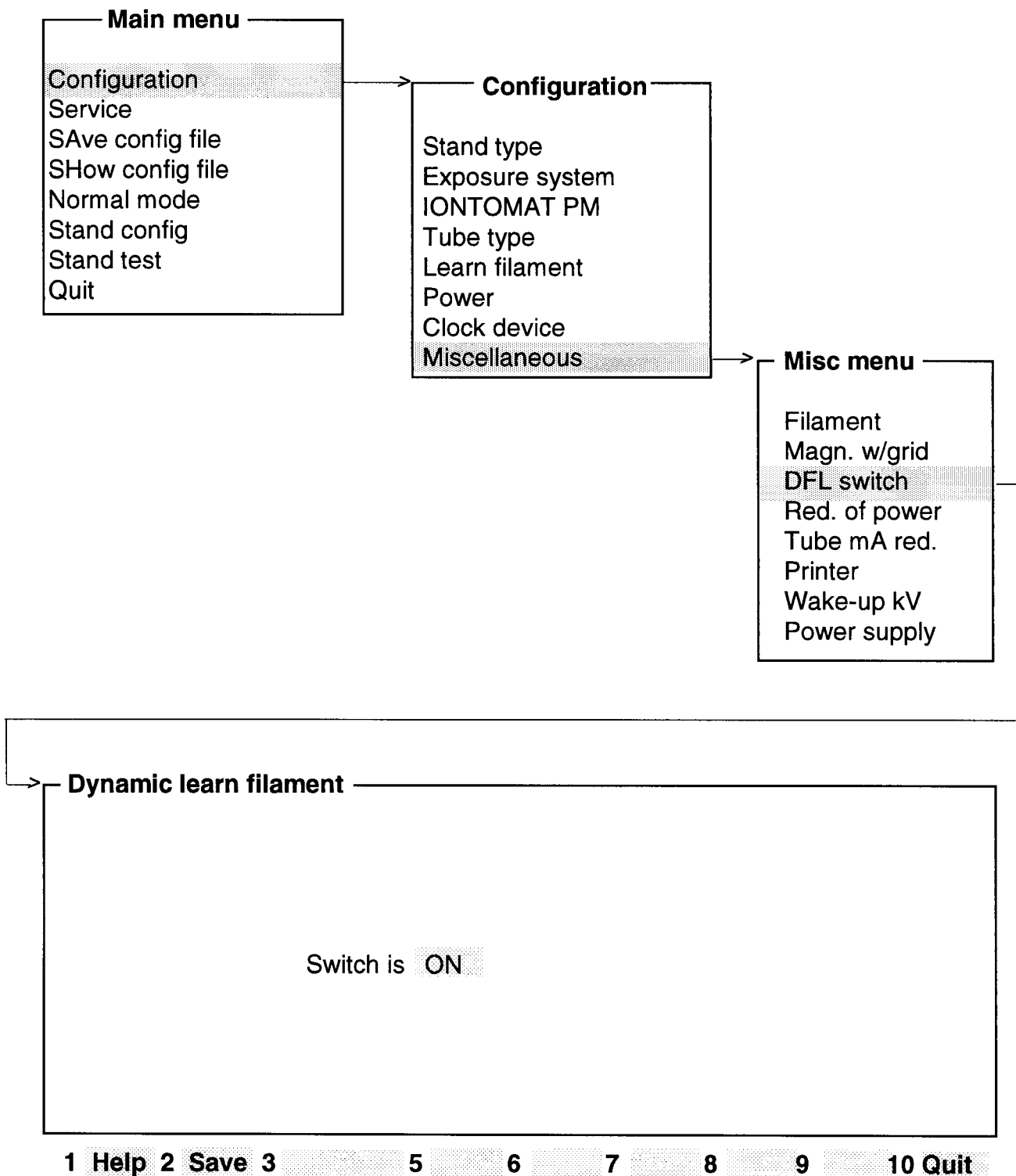
Setting of the date and time for M300 can be done by means of F2.



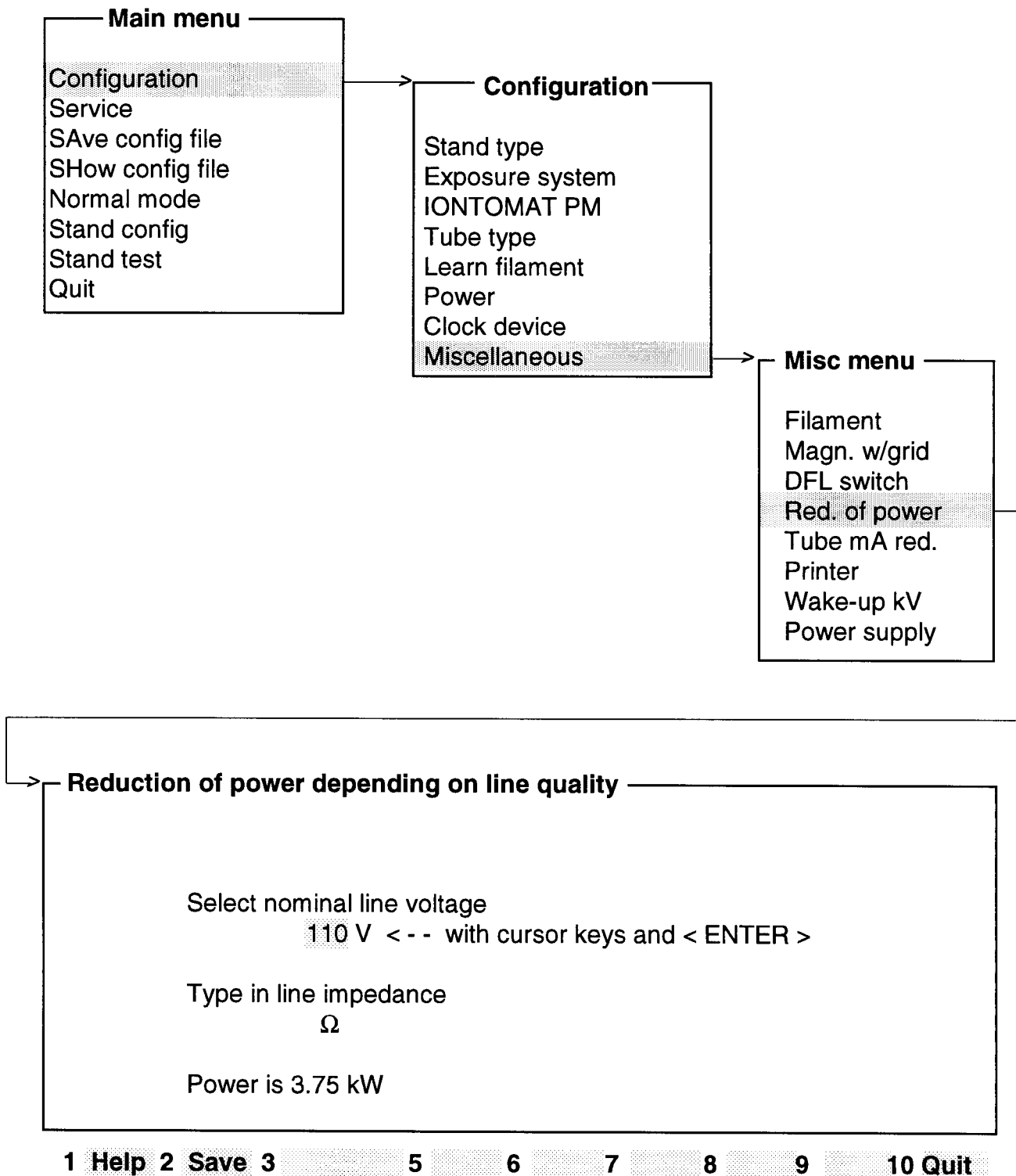
Indicates the adapted filament current for large and small focus respectively.



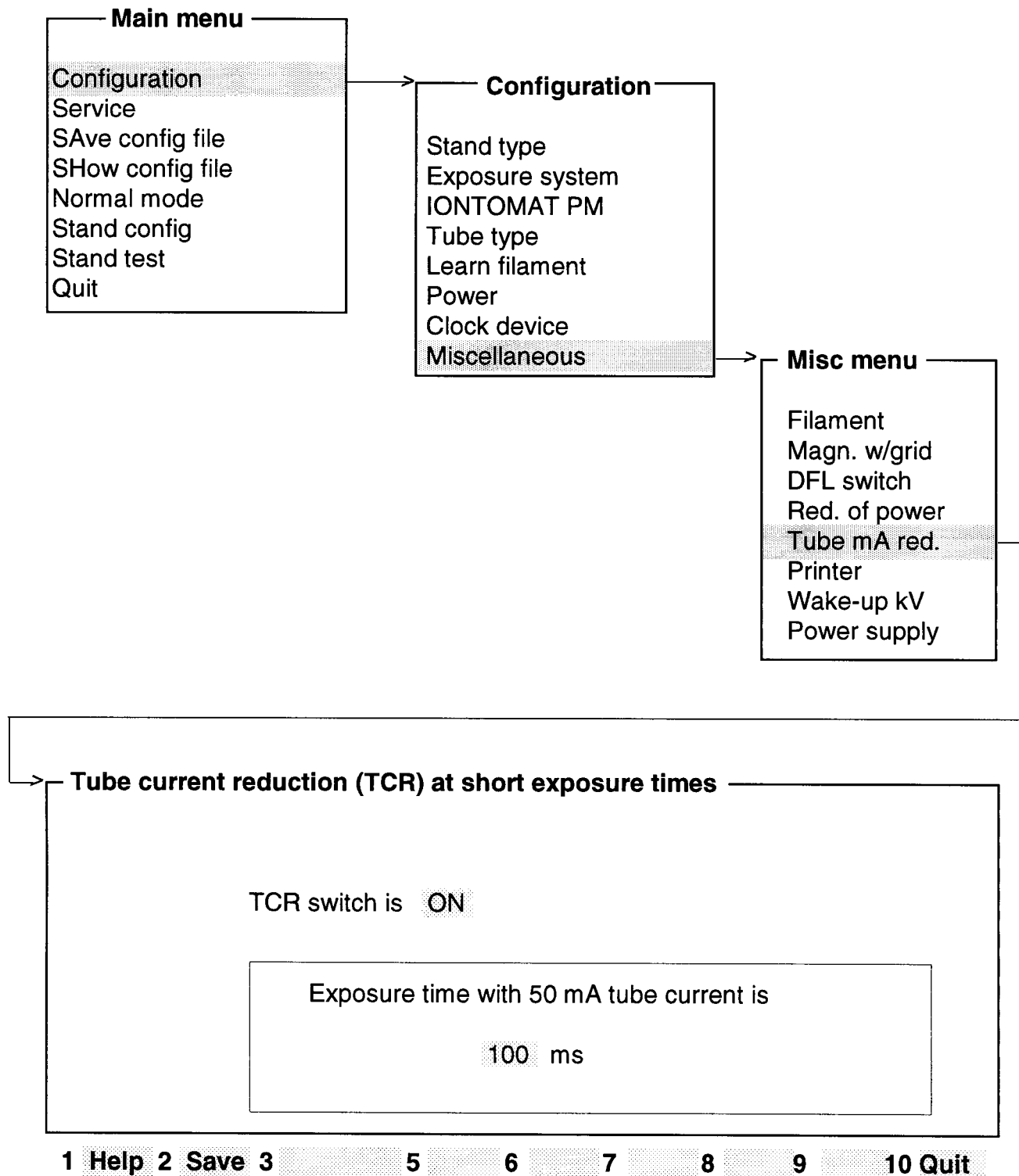
Not used with M300 and shall therefore always be set to OFF.



Activation and deactivation of the filament-current adaption. When activated, the adaption takes place after a total of ten exposures has been made with the actual focus, if the deviation of the average value from the nominal value is within -15% to +5%.



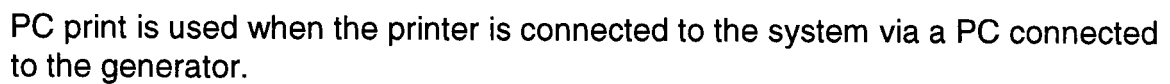
Calculates the maximum power allowed with regard to nominal voltage and line impedance.

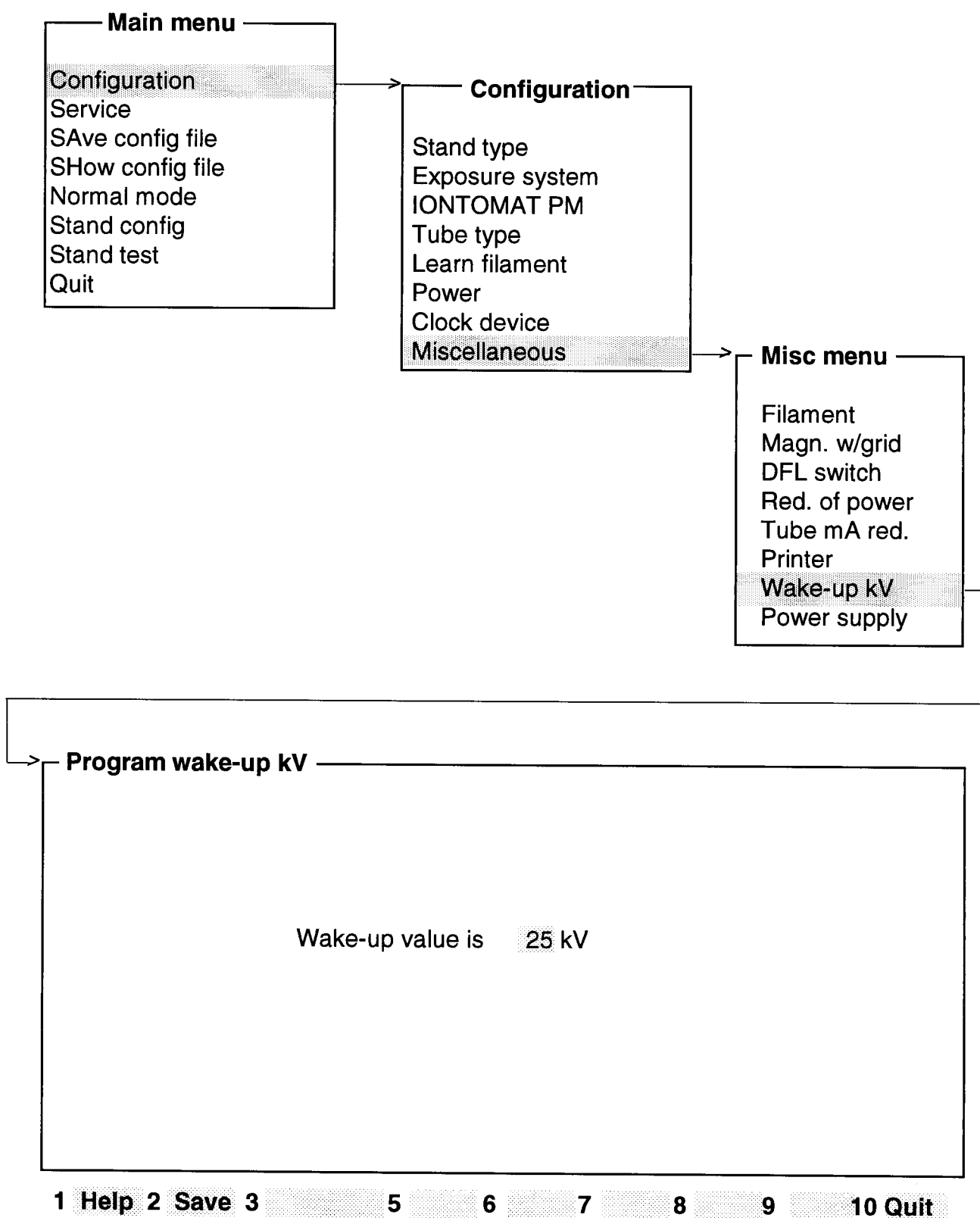


Activation and deactivation of TCR.

When this function is activated, the tube current is reduced to 50 mA, in IONTOMAT mode, at the start of the exposure.

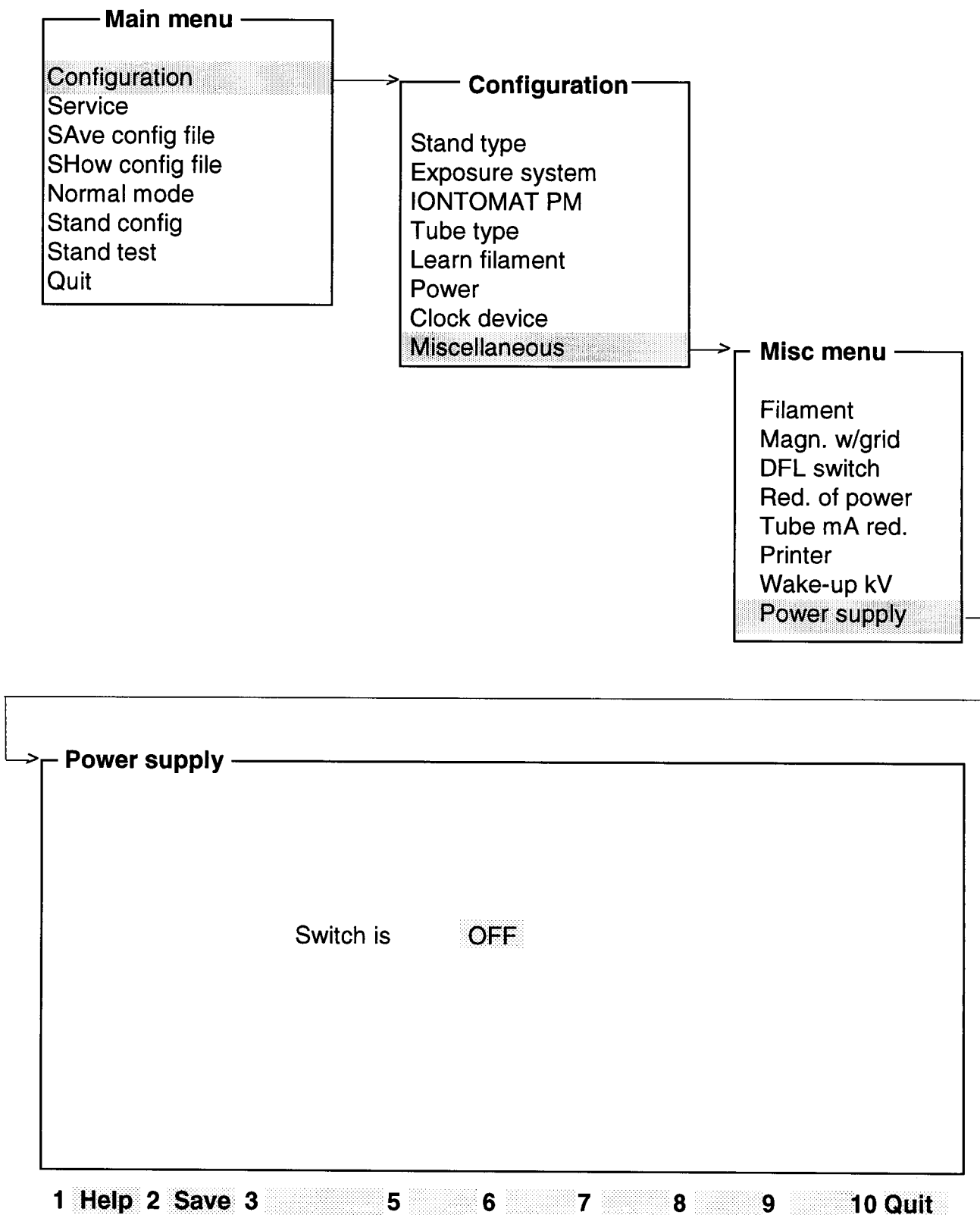
The time for the reduction is selectable between 50 - 450 ms and is displayed in this menu by pressing F2.



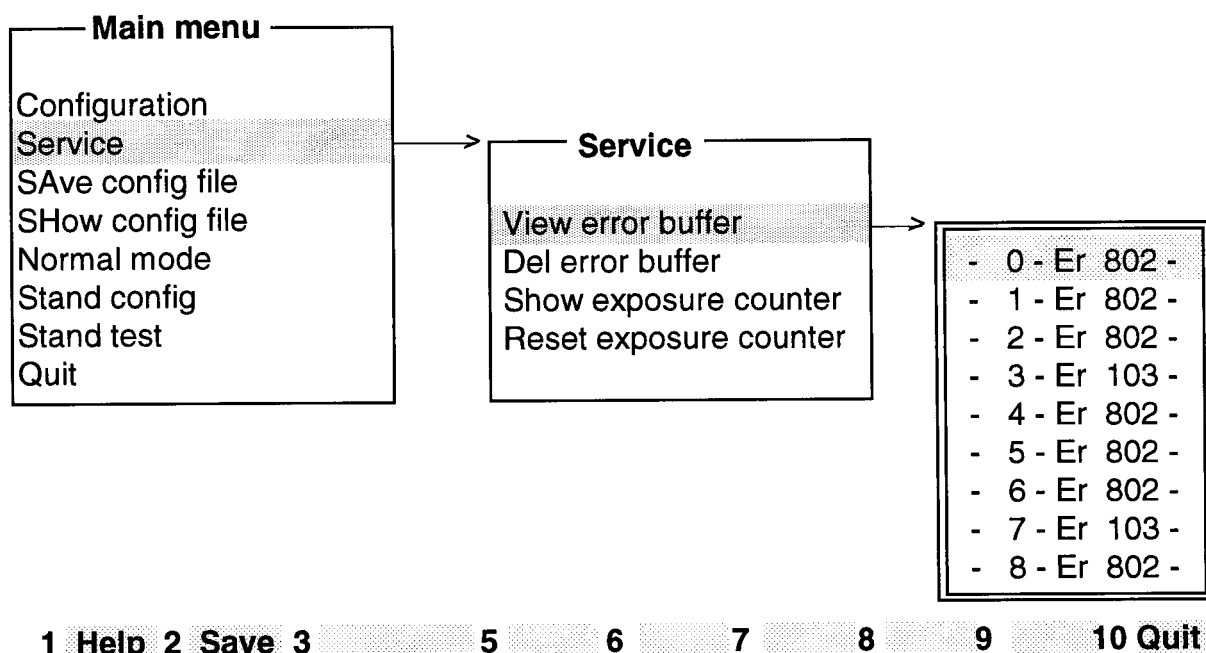


Indicates the kV value that will appear on the kV display when the generator is turned ON.

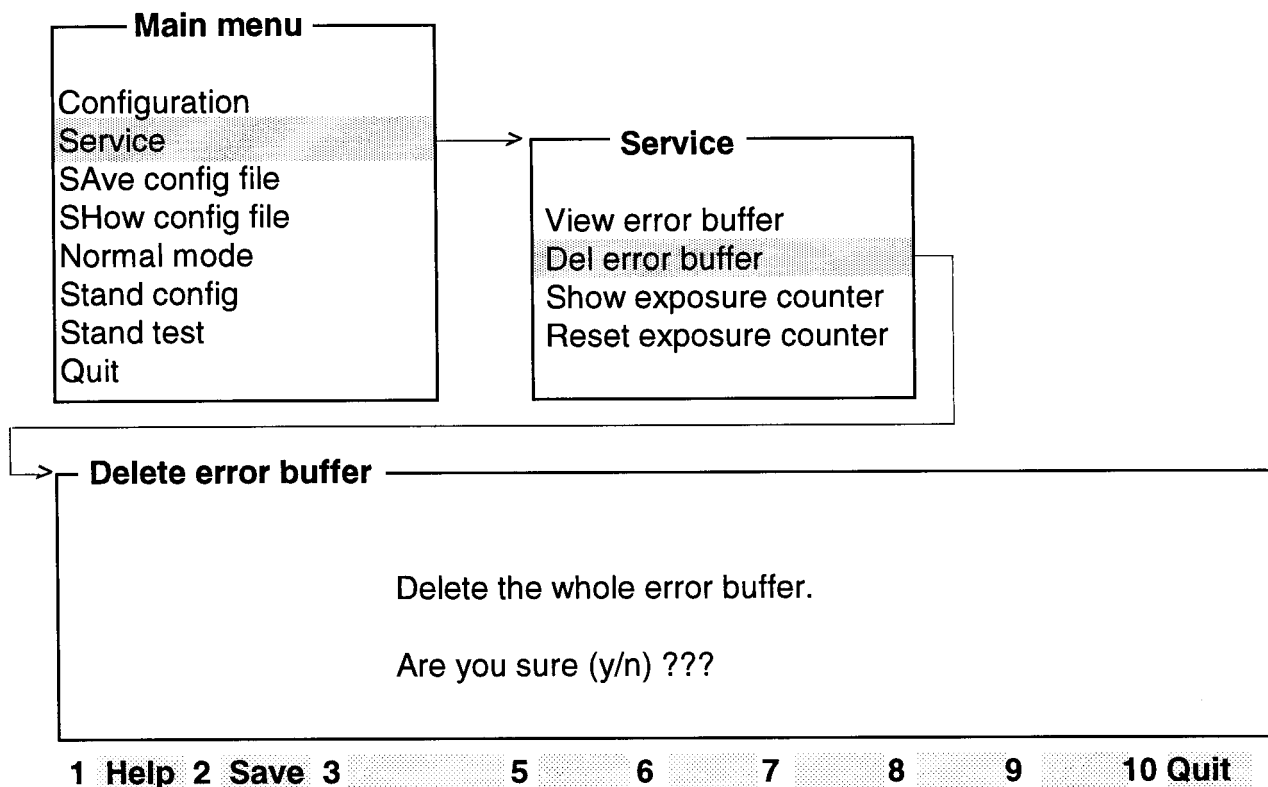
Admissible values: 23 - 35 kV



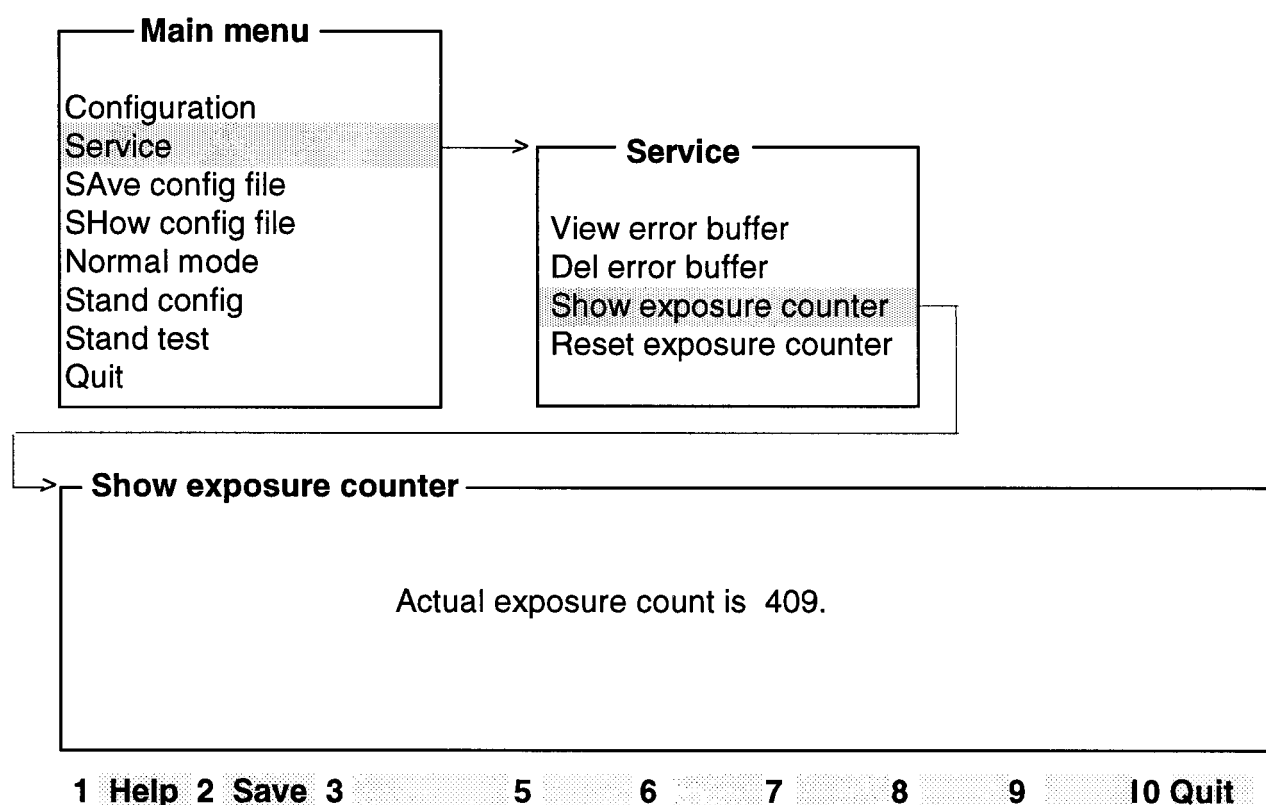
Indicates whether an external power supply is connected or not.



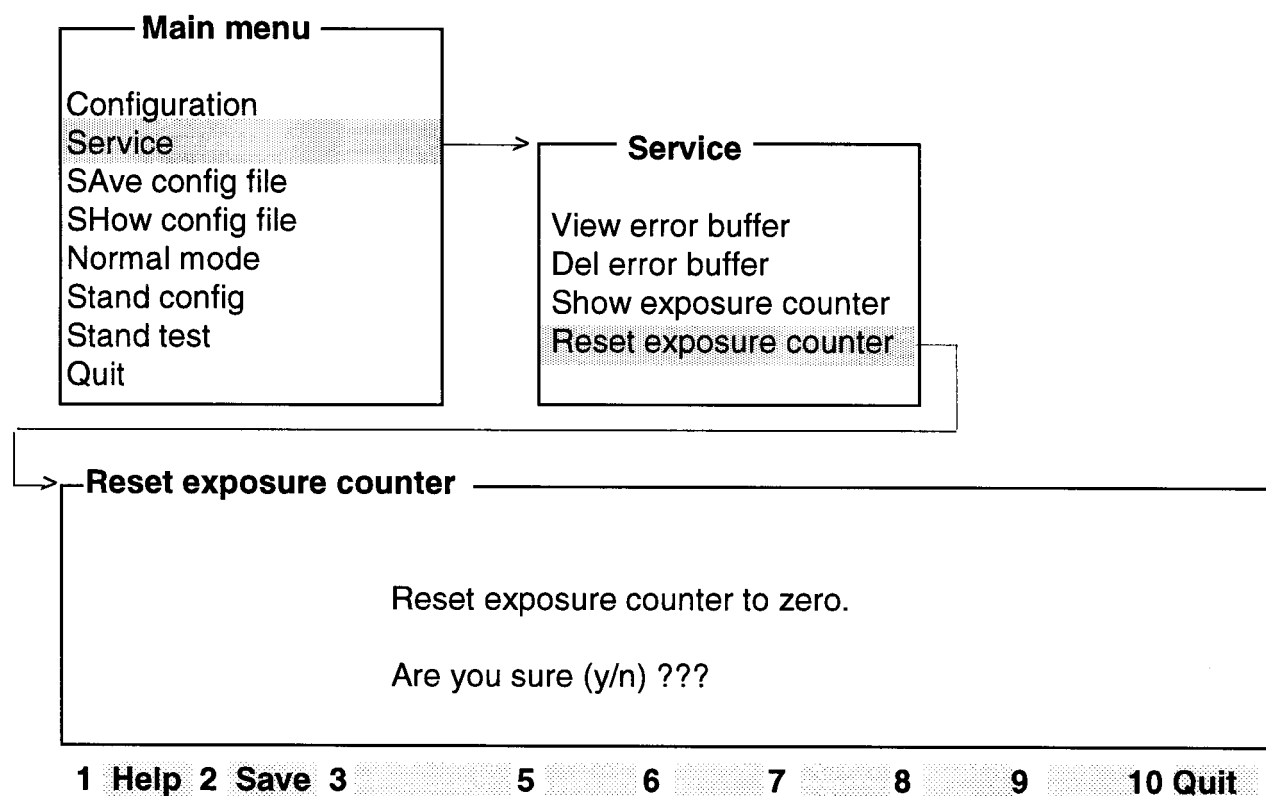
With the selection of the "View error buffer" menu, the error buffer in the panel is read in and displayed on the screen. Using the arrow keys, you can now scroll through the entire error buffer. If you want more detailed information about the indicated error, just press the return key. The error shown at the head of the list is the most recently occurred error. A maximum of 40 errors can be stored.



Selecting the "Delete error buffer" menu and pressing the "Y" key empties the error buffer in the panel. If you then try to call up "View error buffer" again, the service program will respond by displaying the message "Error buffer empty". It is recommended to empty the error buffer after each service!



By selecting the "Show exposure counter" menu, the exposure-counter value in the panel is read in and displayed on the screen.



Selecting the "Reset exposure counter" menu and pressing the "Y" key resets the exposure-counter value in the panel to zero.

Note: Only to be done after tube exchange.

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Save configuration

Main menu

Configuration
 Service
SAve config file
 SHow config file
 Normal mode
 Stand config
 Stand test
 Quit

Save configuration —> mammo. cfg

Stand

Tube	P49 Mo Ø3		
Power	sf 0.70 kW	If	3.75 kW
Filament current	sf 7518 mA	If	6937 mA
Dyn. learn filament	on		
Tube curr. reduct.	on		
Power supply	off		
Sensitivity			
H	11.0		
D	11.0		
Corr. curve	H A2	D A1	
Sens. corr.			
no grid	0.0		
grid	0.0		
magnif.	0.0		

1 Help 2 Save 3 5 6 7 8 9 10 Quit

This menu is used for storing information about the system configuration in the "mammo.cfg" file.

Be sure to save the changes on the service PC diskette,
 that means that you should always work with drive A: or B:.

Main menu

Configuration
Service
SAve config file
SHow config file
Normal mode
Stand config
Stand test
Quit

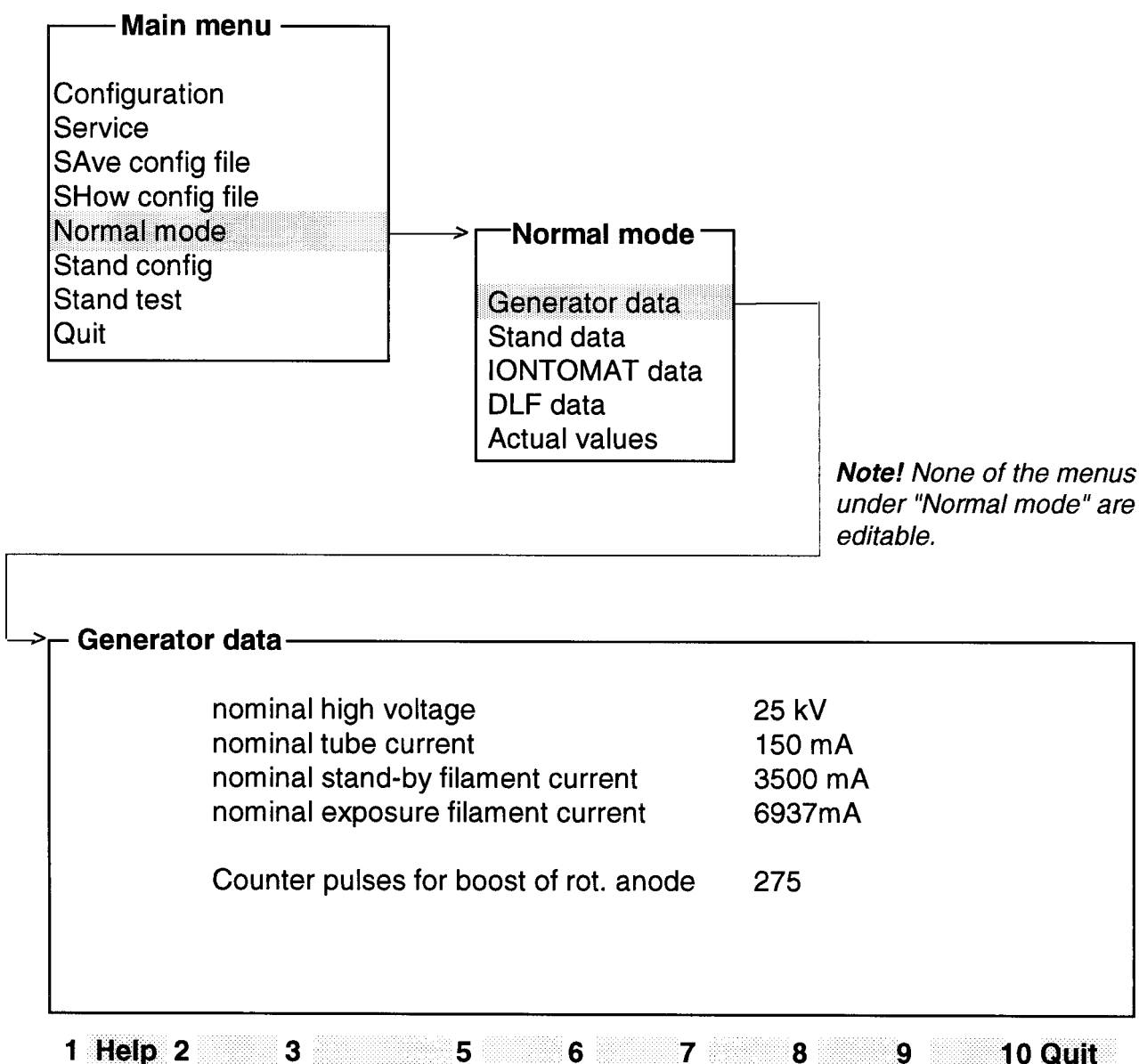
Show file mammo. cfg

Stand

Tube	P49 Mo Ø3		
Power	sf 0.70 kW	If	3.75 kW
Filament current	sf 7518 mA	If	6937 mA
Dyn. learn filament	on		
Tube curr. reduct.	on		
Power supply	off		
Sensitivity			
H	11.0		
D	11.0		
Corr. curve	H A2	D A1	
Sens. corr.			
no grid	0.0		
grid	0.0		
magnif.	0.0		

1 Help 2 3 5 6 7 8 9 10 Quit

This menu displays the system configuration as stored in the "mammo.cfg" file.

**Nominal high voltage:**

Shows the kV set.

Nominal tube current:

Shows the nominal value of the tube current.

Stand-by filament current:

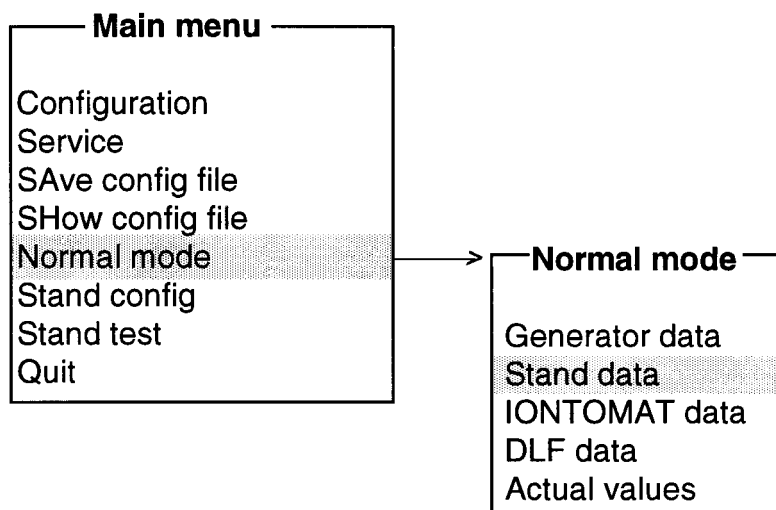
Shows the nominal value of the stand-by filament current.

Exposure filament current:

Shows the nominal value of the filament preparation.

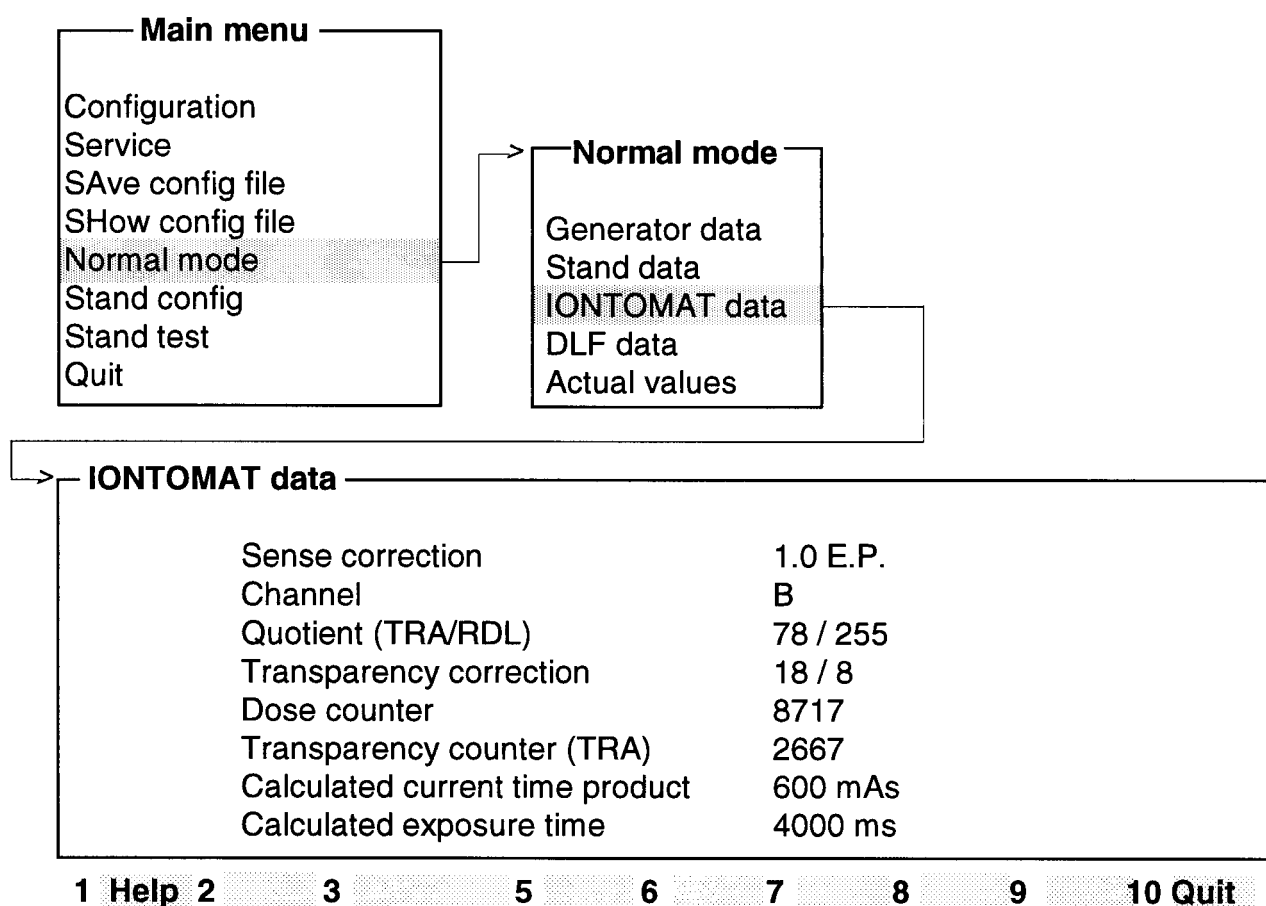
Counter pulses for boost of rot. anode:

Shows the number of inverter pulses used for the anode acceleration.



1 Help 2 3 5 6 7 8 9 10 Quit

Not used with M300.

**Sense correction:**

Shows the sum of the density correction programmed via the "Sens. corr" menu and the density correction set on the control deck.

Channel:

Indicates which IONTOMAT channel is used. Channel B is always used with M300.

Quotient (TRA/RDL):

Indicates the ratio between the dose pulses for upper and lower detector.

Transparency correction:

Dependent on the film - screen combination and the object, a density correction takes place automatically. The digit indicates the size of the correction.

Dose counter (RDL):

Number of pulses from upper detector.

Transparency counter (TRA):

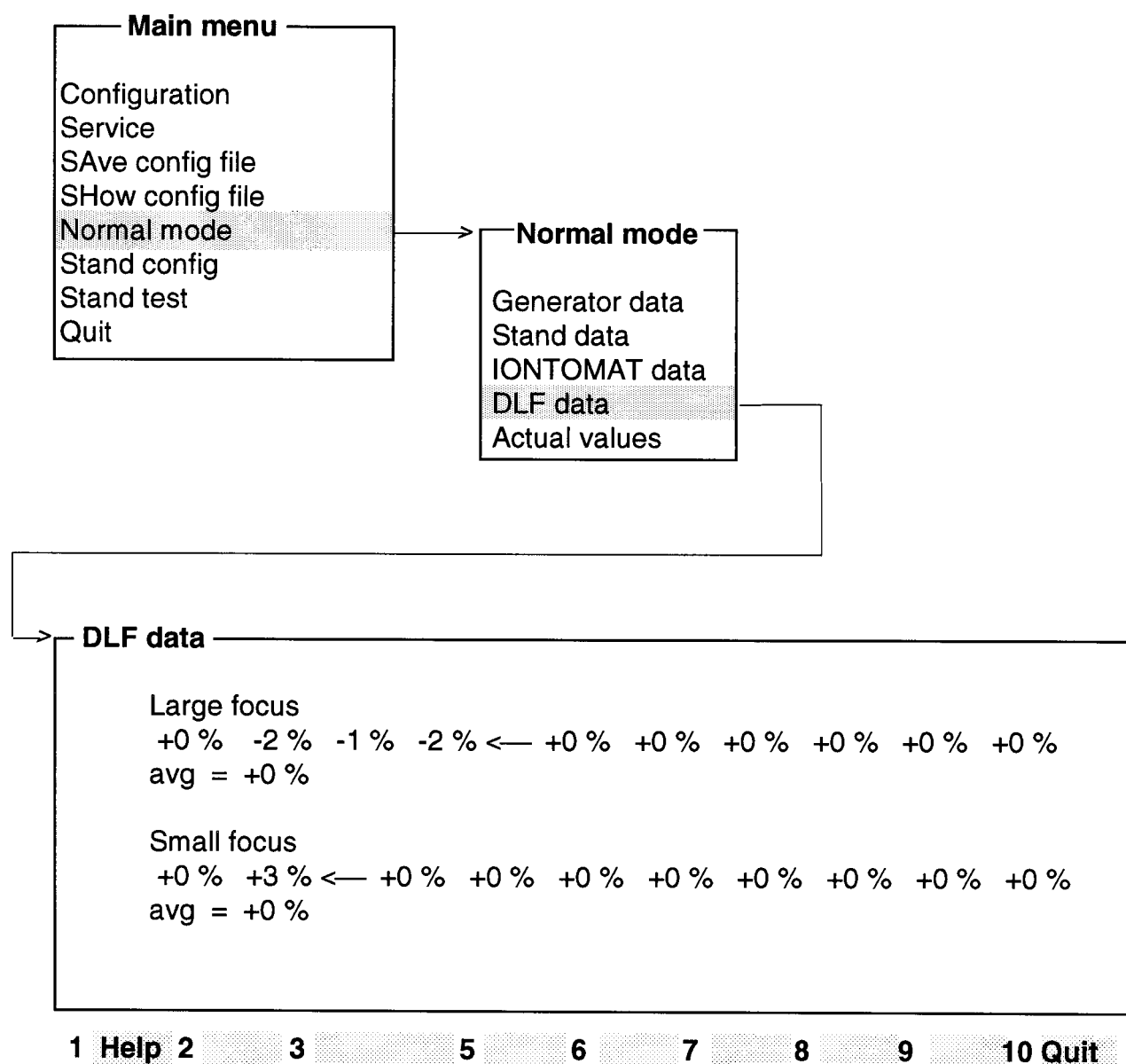
Number of pulses from lower detector.

Calculated current/time product:

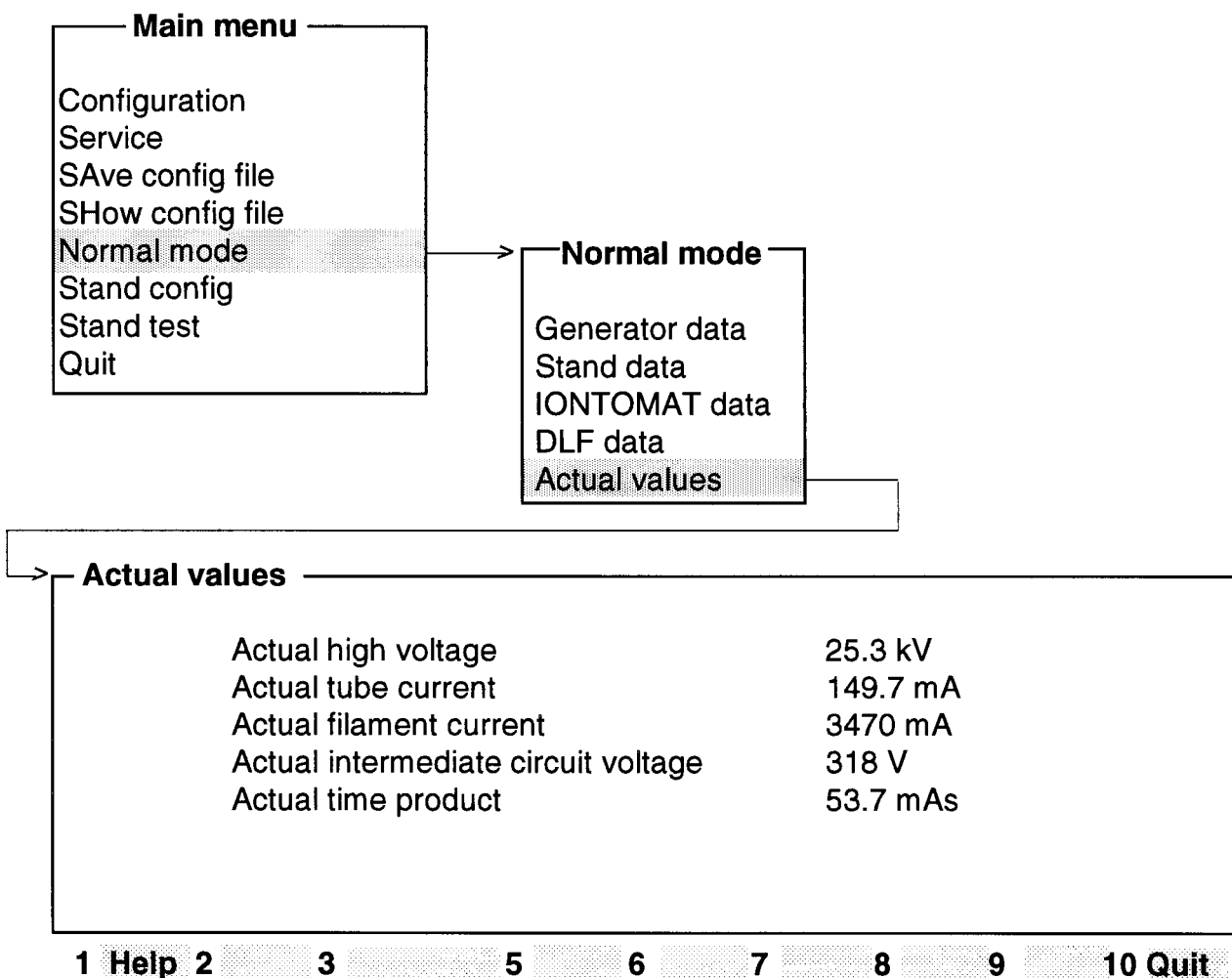
Shows the maximum mAs value allowed for selected operating mode.

Calculated exposure time:

Shows the maximum exposure time allowed for selected operating mode.



This menu shows the percentage deviation between actual and desired tube current as well as the average deviation for the last ten exposures.
The arrow indicates the latest exposure.



Actual high voltage:

Shows the actual kV at the start of the exposure.

Actual tube current:

Shows the actual tube current at the start of the exposure.

Actual filament current:

Shows the actual stand-by filament current.

Actual intermediate circuit voltage:

Shows the intermediate circuit voltage applied at the start-up of the unit.

Actual current/time product:

Shows the mAs value for the latest exposure.

General

This service program is similar to earlier mammo PC programs.

In the "Stand config" mode, there are a number of values that can be read with the PC prior to programming them.

In that case, the key **F3** has the text **Calibrate**.

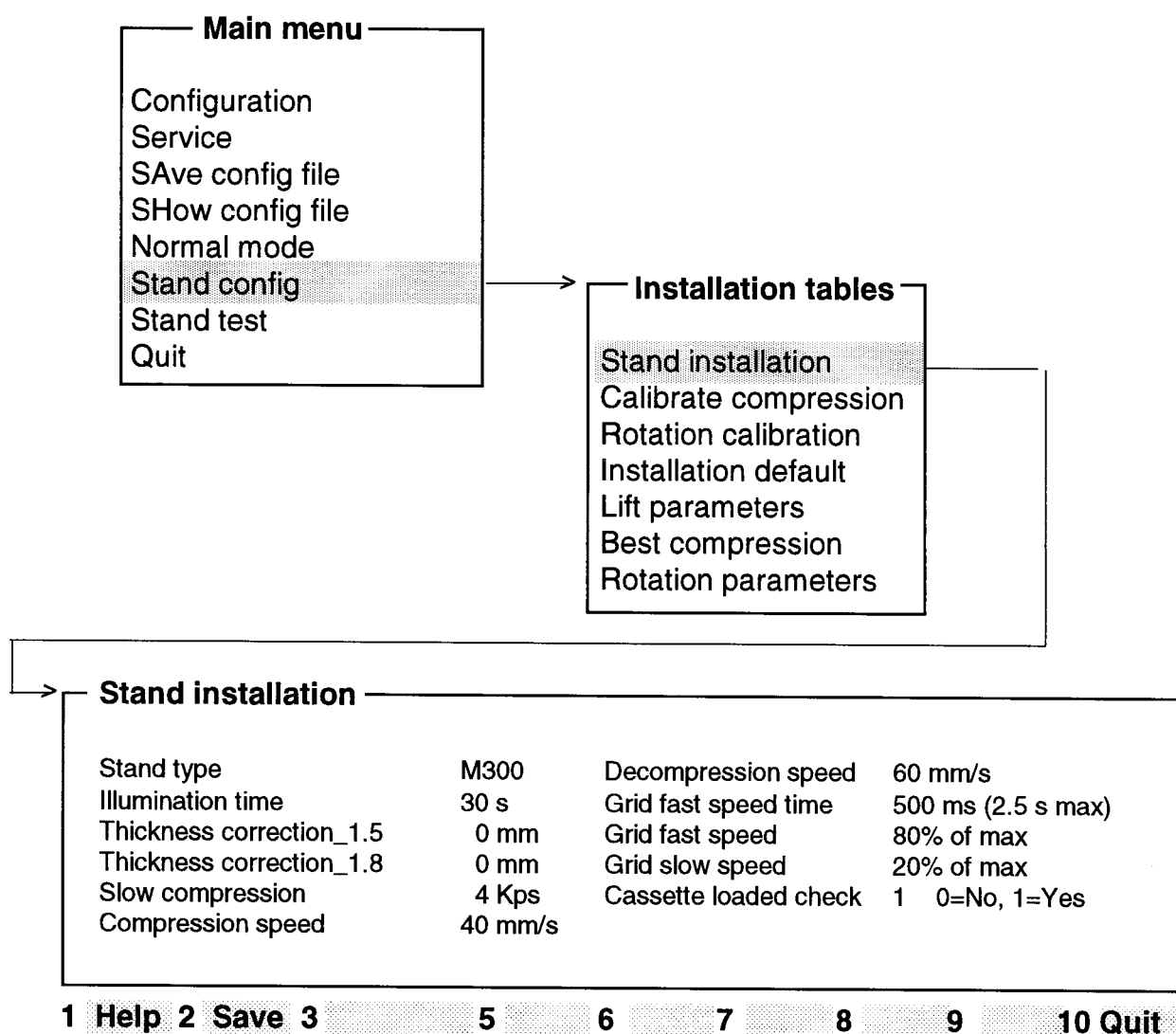
Highlight the field of interest by moving the cursor with the Tab or arrow key and press **F3**.

(An error is indicated on the PC if that particular value cannot be read, i.e. thickness bottom, mm. Press **ESC** to return.)

The actual value of the parameter will appear. Press the **ESC** key, enter the value read above in the proper field. Several fields can be updated in this manner before saving (**Save**) the changes with **F2**.

Saving the changes writes them to the stand EEPROM, where they remain until reprogrammed.

Leaving the menu without saving causes the change(s) to be lost.



Continued on next page ⇒

Stand type:

Indicates type of stand.

Illumination time:

Duration of switched-on field light
(collimator lamp): 1 - 99 s

Thickness correction_1.5:

Correction factor for calculating the
height of the compression plate
above the '1.5 factor' magnification
table. Admissible values: 0 - 99 mm
Normally set to: 0 mm

Thickness correction_1.8:

Same as above, but for the
'1.8 factor' magnification table.
Admissible values: 0 - 99 mm
Normally set to: 0 mm

Slow compression:

When the compression force exceeds
1 kg (10N) , the speed control of the
compression is discontinued.
Instead, the force increase per time
unit is controlled. The digit indicates
the force increase per time unit,
which this function will control.
Admissible values: 1 - 99 Kp/s

Compression speed:

Speed of compression plate in mm/s
during compression.
Admissible values: 1 - 80. A higher
value will not generate any error, nor
will it cause any speed increase.

Decompression speed:

Speed of compression plate in mm/s
during decompression. Same values
as above.

Grid fast speed time:

The time during which the grid is
moving at high speed after start of
radiation.
Admissible values: 10 - 2500 ms.

Grid fast speed:

Indicates the high-speed reciproca-
tion of the grid applied after start. The
speed is indicated as a percentage
of the maximum pulse width of the
grid motor-control signal.
Admissible values: 1 - 99

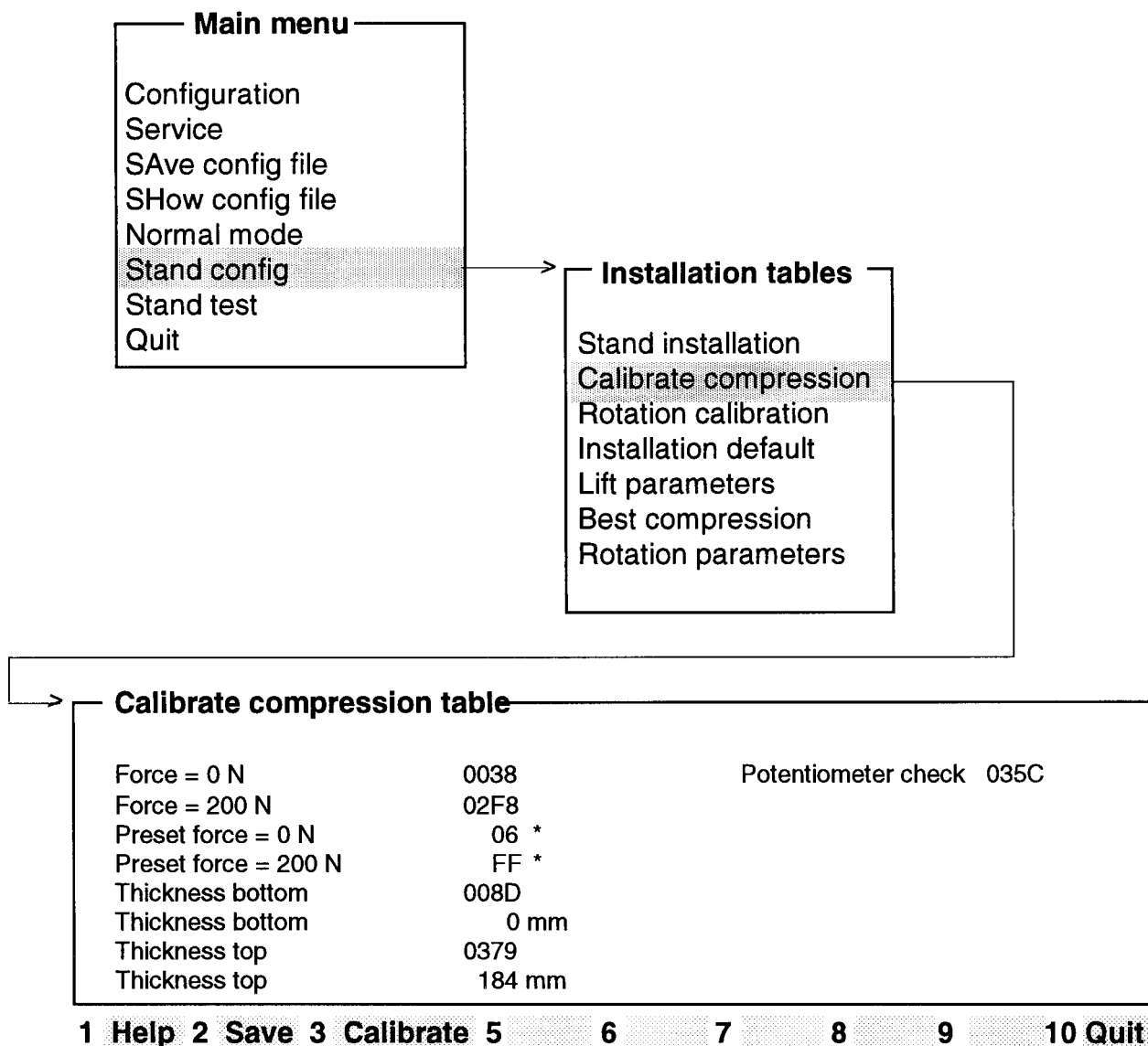
Grid slow speed:

Indicates the low speed of the grid
after transition from high speed. The
speed is indicated as a percentage
of the maximum pulse width of the
grid motor-control signal.
Admissible values: 1 - 99

Cassette loaded check:

0 = function deactivated
1 = function activated

With this function activated, the
cassette symbol on the control panel
will be lit after a film cassette has
been exposed, or if no film cassette is
inserted in the object table (exposure
release is now blocked). The film cas-
sette must be exchanged after each
exposure.

**Force = 0 N**

Sampled calibration value for the force sensor at a compression force of 0 N after running the compression plate downwards. Stop before reaching the object table.

Force = 200 N

Sampled calibration value for the force sensor at a compression force of 200 N. Put the scale on the object table and compress to 200 N by motor only. If 200 N is exceeded, restart from 0 N!

* Start with these adjustments.

Preset force = 0 N

Sampled calibration value with the preset force potentiometer set to minimum (turned counterclockwise to end position).

Preset force = 200 N

Sampled calibration value with the preset force potentiometer set to maximum (turned clockwise to end position).

Thickness bottom

Sampled calibration value for the thickness sensor, when the compression plate is in bottom position.

Continued on next page ⇒

Thickness bottom (mm)

Measured distance between compression plate and object table, when the compression plate is in bottom position.

If the compression plate reaches the object table (normal case), type in 0.

Thickness top

Sampled calibration value for the thickness sensor, when the compression plate is in uppermost position.

Thickness top (mm)

Measured distance between compression plate and object table, when the compression plate is in uppermost position.

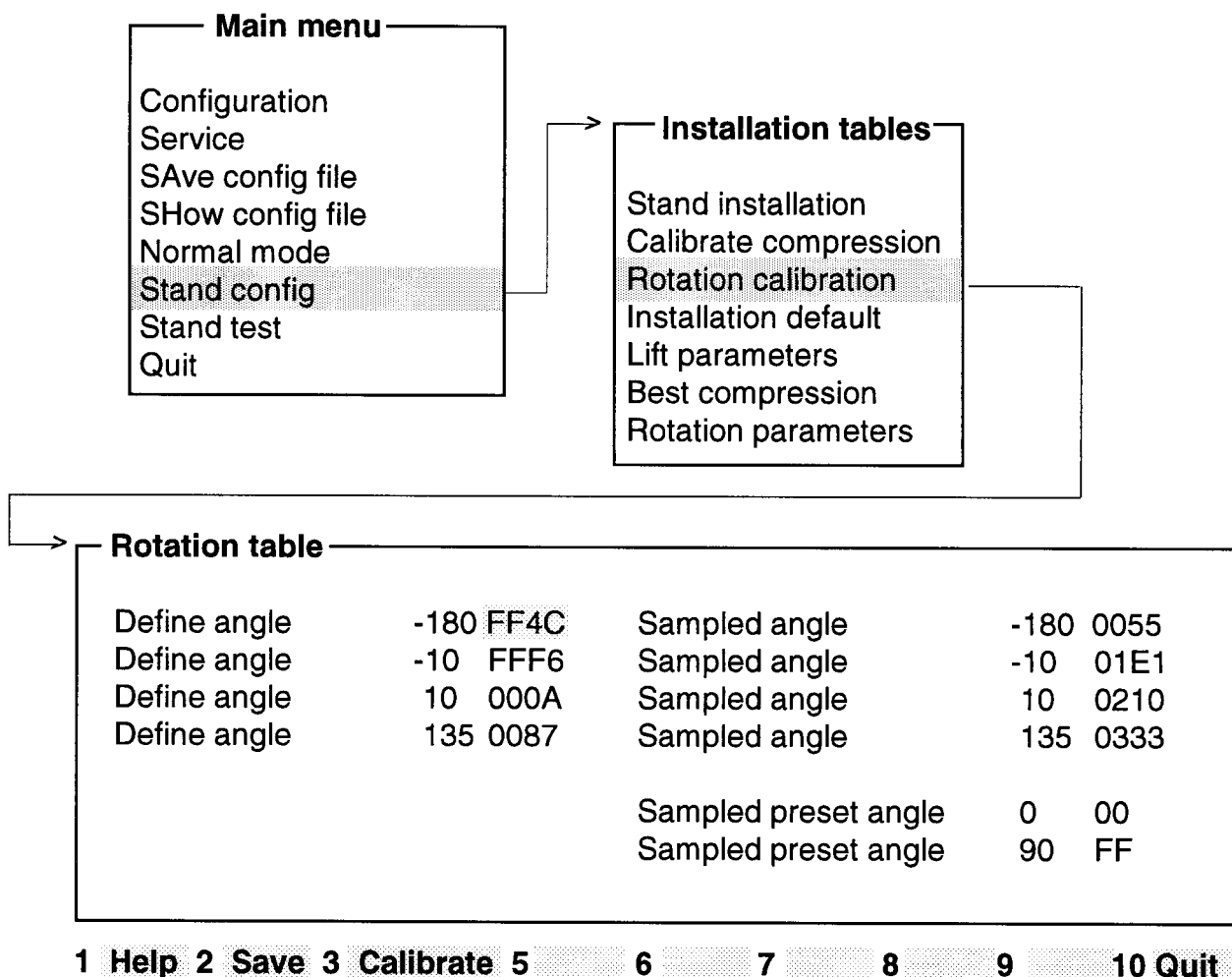
Measure with a ruler.

Potentiometer check

Sampled calibration value for the return current through the four potentiometers 'preset force', 'preset angle', 'thickness' and 'angle'.

This return current is continuously monitored by the system.

Should the return current deviate too much from the calibration value, this is probably due to a faulty potentiometer or due to contact failure with one of the potentiometers, which results in error code 825 or 826.

**Define angle -180 / +135**

Defines angles -180°/+135°. The default values are correct.

Define angle -10 / +10

Values may be programmed 1 degree + or - from default values. Possible other values are FFF5 and 0009 or FFF7 and 000B. These values should be entered from the Installation Parameters for the machine.

Sampled angle -180 (see Note 4 - 33)

Run the rot. motor to -180° (this is just before the mechanical stop). If -180° cannot be reached, program (and save) 0000 sampled angle -180°. When the angle is correct, read the value with F3, press ESC, enter the read value and save it with F2.

Sampled angle +135 (see Note 4 - 33)

Run the motor to +135° (this is just before the mechanical stop). If +135° cannot be reached, program (and save) 03FF. When the angle is correct, reprogram it.

Sampled angle -10 / +10 (see Note)

These values are automatically determined each time they are passed in the direction towards 0° (provided that -180° and +135° are properly programmed and saved). They should be programmed, so that the display will show the correct angle at turn ON. Rotate from +135° to -90° and back to 0°. Highlight sampled angle -10. Press F3, note the two values -10 and +10, press ESC, program and save the two values.

Continued on next page ⇒

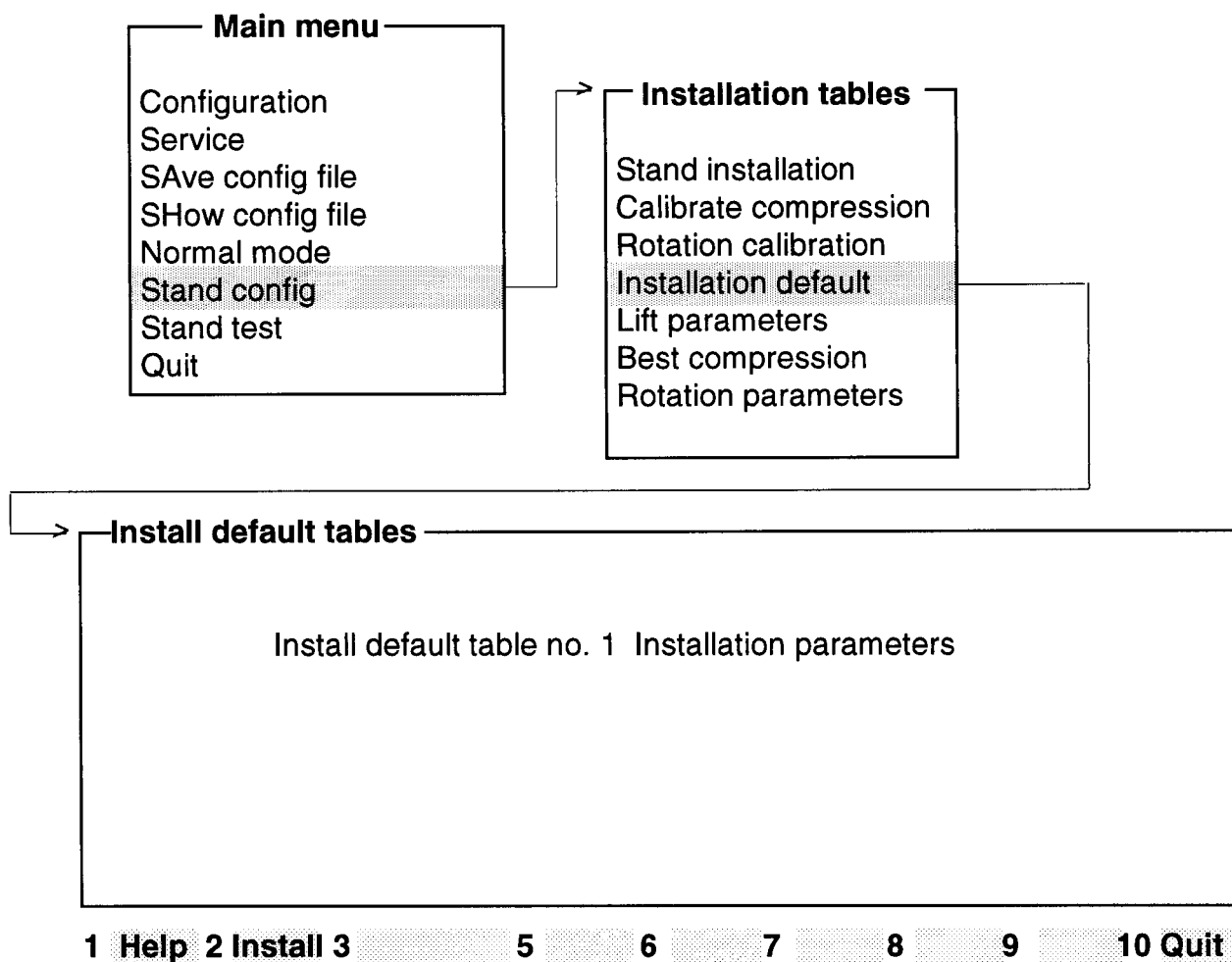
Sampled preset angle 0

Sampled calibration value for the pre-set angle potentiometer when set to minimum (turned counterclockwise to end position).

Sampled preset angle 90

Sampled calibration value for the preset angle potentiometer when set to maximum (turned clockwise to end position).

Note: The sampled angles must be reprogrammed if the tube angle pot. R803, or the CPU D801 is changed.

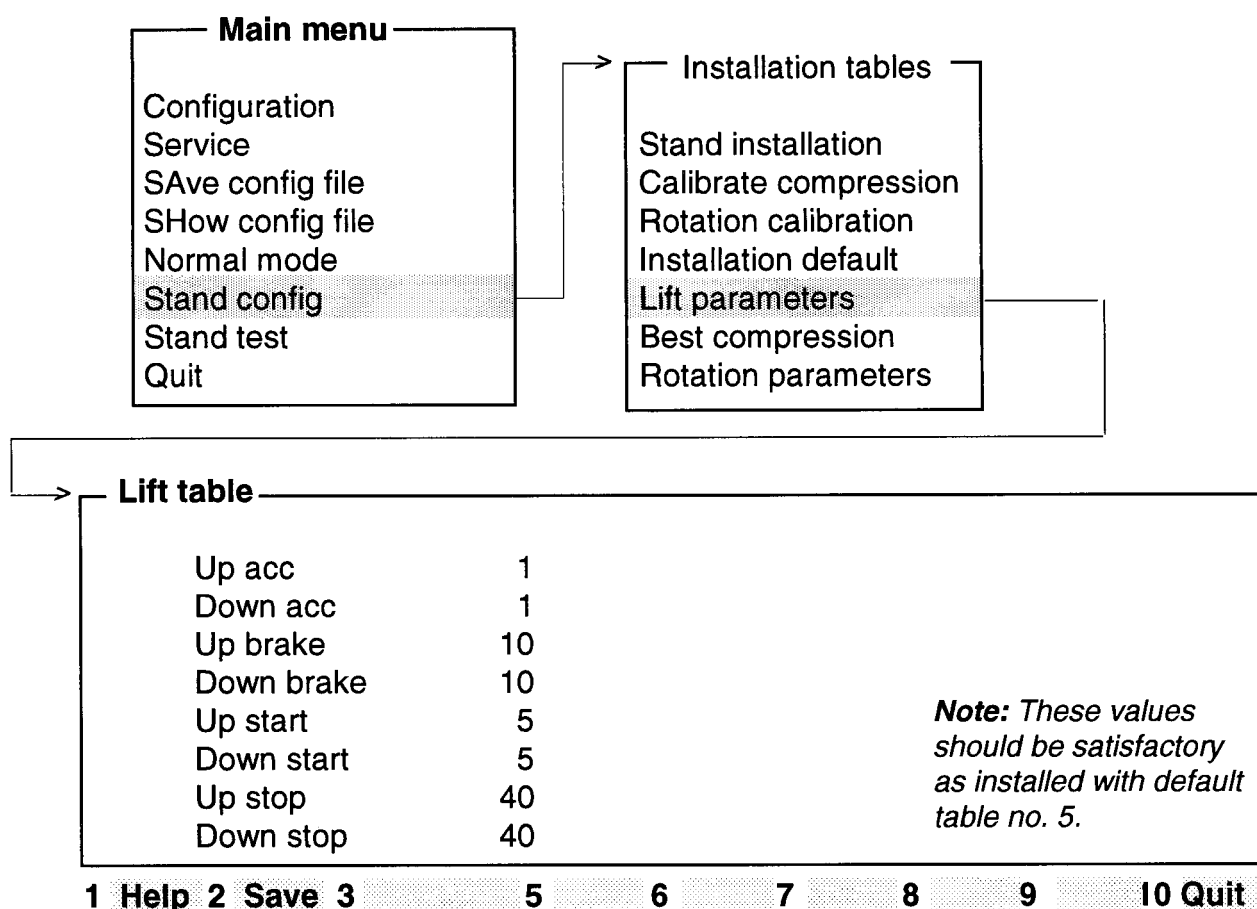


Install default

Under this menu you will find default tables for all stand functions:

- | | |
|--|--|
| Table1: Installation parameters | 6: Setting the optimal compression, part 1 |
| 2: Compression calibration | 7: Setting the optimal compression, part 2 |
| 3: Calibration of rotation angle, part 1 | 8: Setting the rotary motion, part 1 |
| 4: Calibration of rotation angle, part 2 | 9: Setting the rotary motion, part 2 |
| 5: Setting the lift movement | |

These default tables are of great help when recalibration of the system, or parts of it, is required. To install a table, select the table no. with the spacer and then press F2.

**Up acc**

To attain desired acceleration of the lift movement, the pulse width of the motor-control signal is ramped up.

The digit is a measure of the acceleration rate at the start of the lift movement in upward direction. It indicates the increase of the duty cycle on the signal for each change event, which occurs every 10 ms.

Admissible values: 1 - 99

signal for each change event, which occurs every 10 ms.

Admissible values: 1 - 99

Down brake

Same as above, but for downward lift movement. Admissible values: 1 - 99

Up start

To enable instantaneous start of the upward movement, the motor-control signal starts with a predetermined pulse width. The digit is a measure of the size of the pulse width (in percentage of the supply voltage). Increase value, if movement does not start instantaneously, decrease value if movement starts too abruptly.

Admissible values: 1 - 99

Down acc

Same as above, but for downward lift movement.

Admissible values: 1 - 99

Up brake

To attain desired deceleration of the lift movement, the pulse width of the motor-control signal is ramped down. The digit is a measure of at which deceleration rate the upward lift movement shall stop. It indicates the decrease of the duty cycle on the

Down start

Same as above, but for downward movement.

Admissible values: 1 - 99

Continued on next page ⇒

Up stop

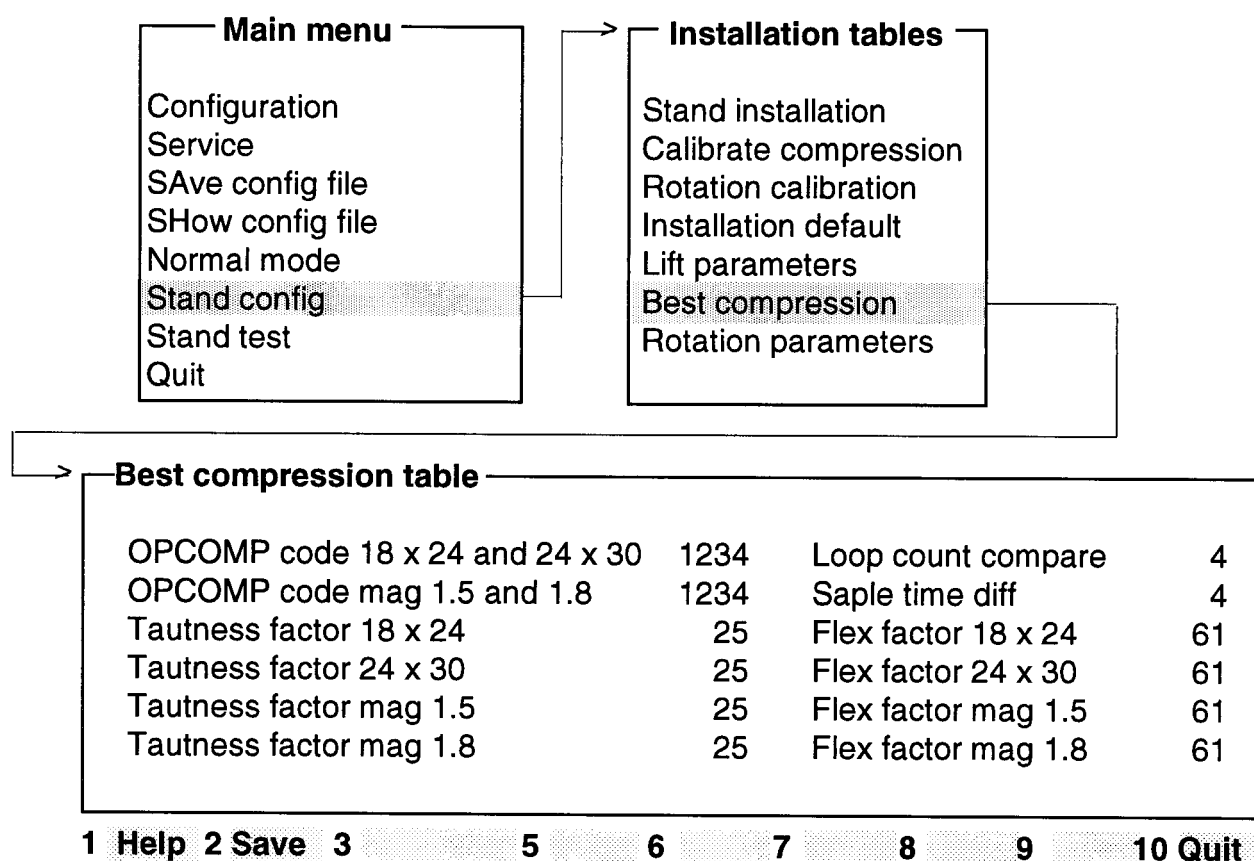
At upward movement, the parameter indicates at which duty cycle the ramping of the pulse width is interrupted and the pulse width set to zero.

Admissible values: 1 - 99

Down stop

Same as above, but for downward movement.

Admissible values: 1 - 99



OPCOMP code 18 x 24 and 24 x 30

OPCOMP code mag 1.5 and 1.8

Enable or disable OPCOMP.

A correctly entered code will enable OPCOMP.

must be fulfilled, before the compression is terminated and the indicator lamp for optimal compression is switched on.

Admissible values: 1 - 99

Tautness factor 18 x 24

24 x 30

mag 1.5

mag 1.8

This factor determines the compression force applied on the breast.

Lower tautness factor causes a harder compression of the breast.

Sample time diff

A thickness sample is taken every 30 ms. The digit indicates the time difference in steps of 30 ms between the sampled values used for calculating the average values.

Example: 01 ⇒ each sample is taken into calculation
02 ⇒ every second sample is taken into calculation

Admissible values: 01 - 99

Loop count compare

Indicates the number of times the condition for optimal compression

Continued on next page ⇒

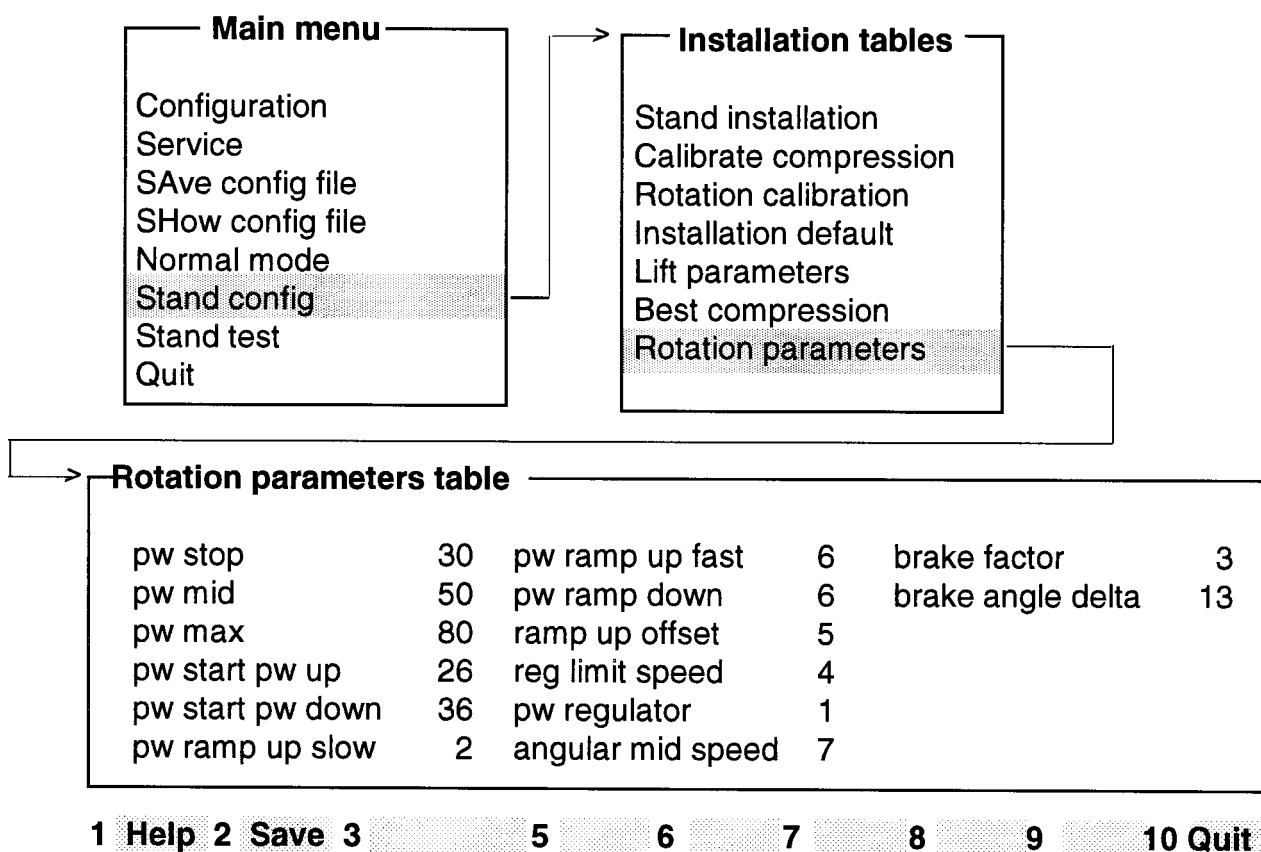
Flex factor 18 x 24
 24 x 30
 mag 1.5
 mag 1.8

A value of the flexibility of the mechanical system.

The value is usually factory-defined.

Note:

See also OPCOMP installation instructions



pw stop

When the tube assembly is getting near the nominal value, the speed of rotation is reduced to make the tube assembly stop in time and thus not pass the nominal value. This reduction is achieved by ramping down the pulse width on the motor-control signal. pw stop represents the duty cycle on this signal, where the

ramping is interrupted.
 Admissible values: 1 - 99

pw mid

To attain desired acceleration of the rotary motion, the pulse width is ramped up from a start value to the duty cycle, which corresponds to the

Continued on next page ⇒

desired speed. The ramping starts at low speed and changes into high speed when a certain break point is reached.

The digit indicates this break point, which represents the duty cycle on the motor-control signal, where the change into higher ramping speed takes place.

Admissible values: 1 - 99

pw max

Indicates maximum angular speed at rotation. The digit indicates the duty cycle on the motor-control signal.

Admissible values: 1 - 99

pw start pw up

To ensure that the rotary motion starts immediately with the button actuation, the start-pulse width is separated from 0.

The digit indicates the duty cycle on the motor-control signal, where the ramping starts at rotary motion towards 0°.

Admissible values: 1 - 99

pw start pw down

Same as above, but for rotary motion away from 0°.

pw ramp up slow

Low speed ramping at acceleration.

The digit indicates the increase of the duty cycle on the motor-control signal for each change event, which is determined by the 'ramp up offset'.

Admissible values: 1 - 99

pw ramp up fast

High speed ramping at acceleration.

The digit indicates the increase of the duty cycle on the motor-control signal for each change event, which is determined by the 'ramp up offset'.

Admissible values: 1 - 99

pw ramp down

To avoid rapid stops of the rotation, which might lead to oscillations, the

speed is also ramped down before the nominal value of the preset angle is reached, or when the button is released.

The digit indicates the decrease of the duty cycle on the motor-control signal for each change event, which occurs every 10 ms.

Admissible values: 1 - 99

ramp up offset

Indicates, in steps of 10 ms, at which point the change of the duty cycle shall take place at acceleration.

Admissible values: 1 - 99

reg limit speed

Within a certain range around the nominal value, the modulation from the speed regulator is not changed. The parameter value represents this range, i.e. nominal value $\pm$ reg limit speed.

Admissible values: 1 - 99

pw regulator

Modulation at low speed regulation of the tube-assembly rotation to ensure that the tube assembly stops at the preset angle and does not get stuck. The digit indicates the percentage change of the duty cycle for each change event.

Admissible values: 1 - 99

angular min speed

Before the tube assembly reaches the nominal value of the preset angle, the angular speed is reduced.

When the lower speed is reached, the ramping is terminated and transformed into speed regulation.

The digit indicates the nominal value for this lower speed in degrees/s.

Admissible values: 1 - 99

Continued on next page $\Rightarrow$

brake factor

Since the retardation length varies, it is necessary to start the speed reduction at different points, depending on the preset angle.

The stop angle is decreased with a "+" value or increased with a "-" value.

At 0° this factor has no effect.

Admissible values: 1 - 99

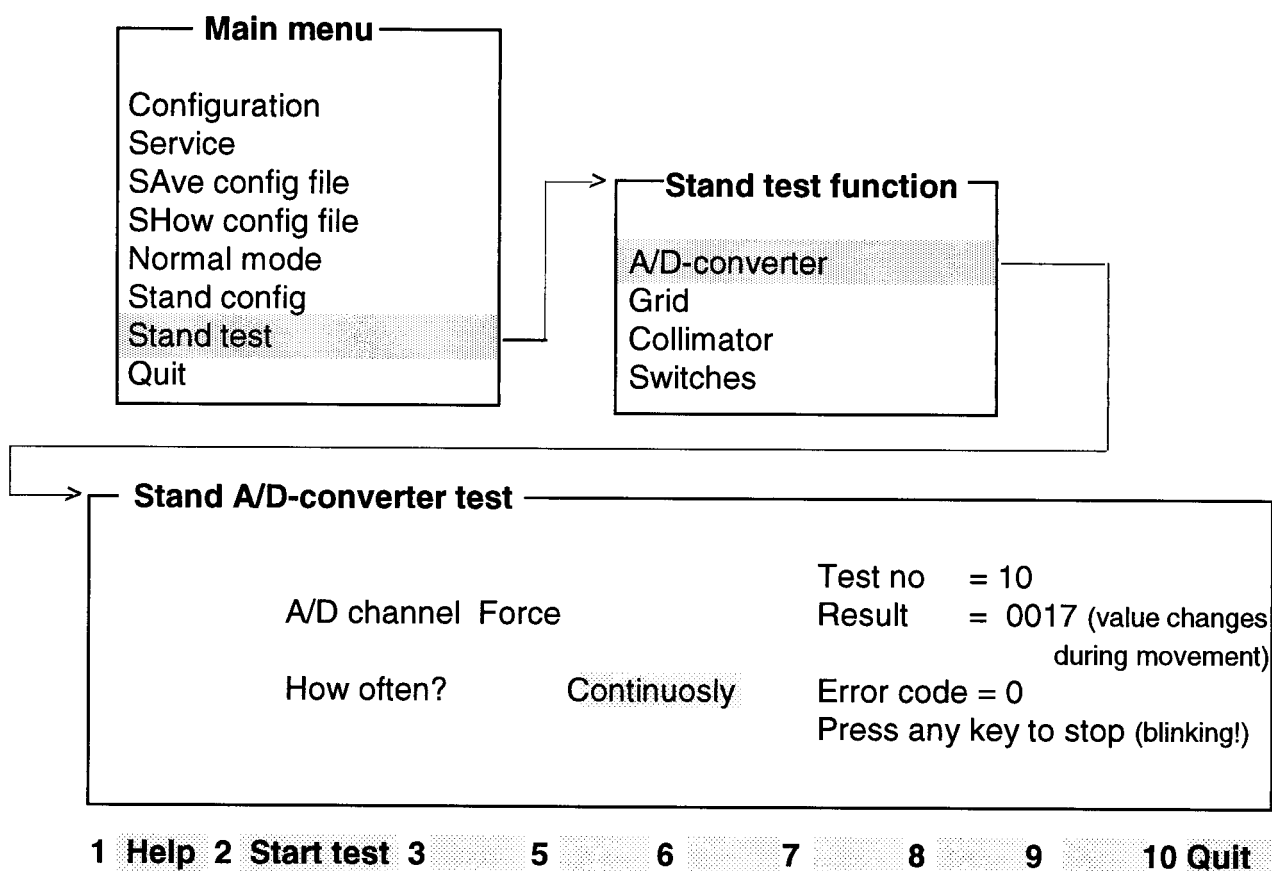
Entered value: 0 - 50 gives a positive value 0 - 50

51 - 99 gives a negative value (longer stop angle at angles other than 0°, i.e.
50 - entered value
e.g. 53 = -3.

brake-angle delta

The value of this parameter indicates at which angle the speed reduction shall start to make the tube assembly stop at 0°.

Admissible values: 1 - 99



A/D converter test

This menu displays two fields for selection of test data. Desired field is selected with the TAB key.

In the first field you can choose which analog input (to the CPU in the stand) shall be read off.

The possible inputs are: Force, Angle, Thickness, Preset force, Preset angle, Grid motor V and Poti check.

In the second field you can choose whether the reading shall be carried out just once or continuously (until interruption).

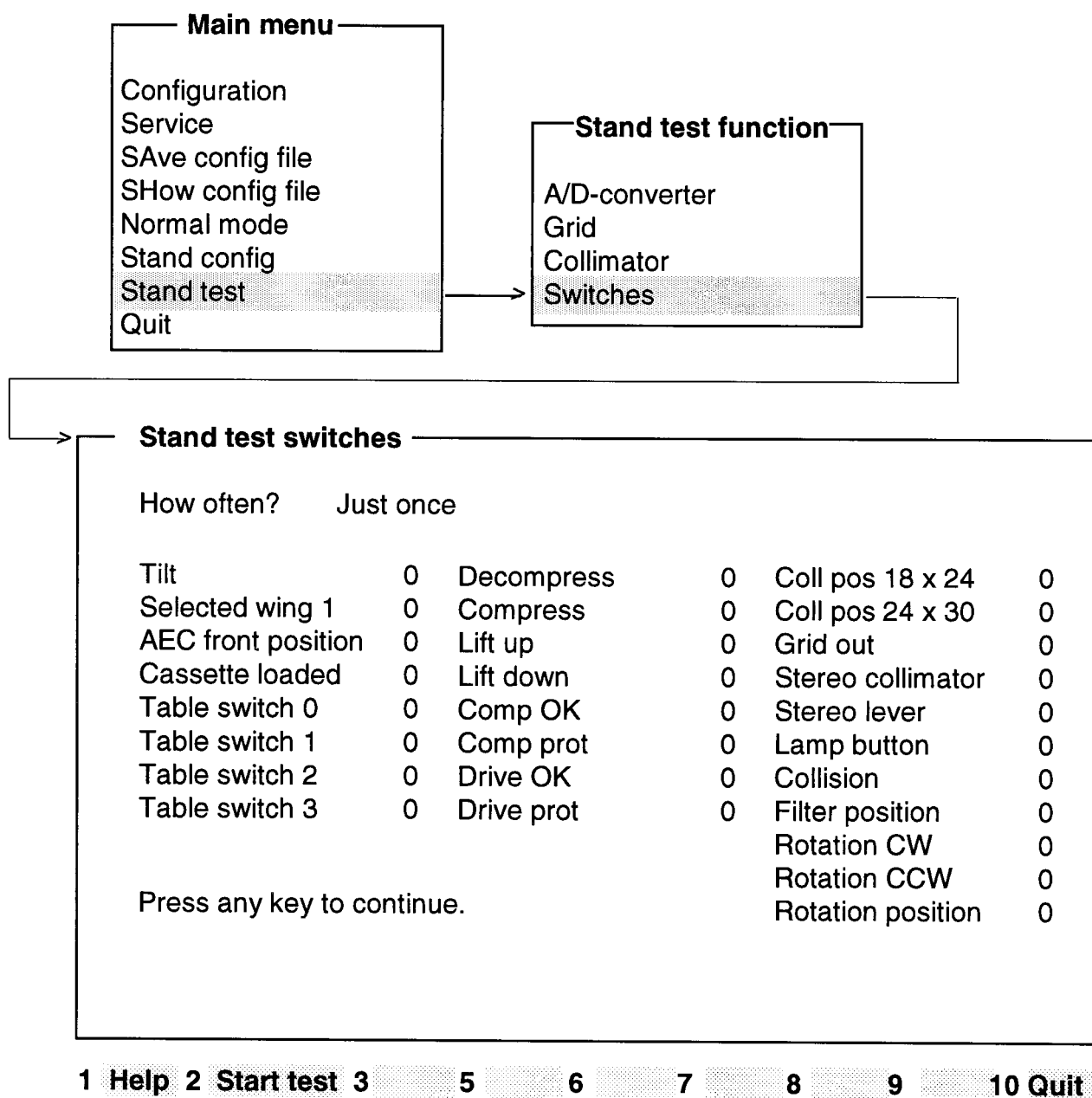
In both fields you can scroll through the different alternatives by pressing the spacer. Press F2 or the return key to read off desired alternative.

Grid test

Selection of this menu immediately starts the grid test. If a grid-movement error is detected, an error message is displayed, as usual, on the control panel.

Collimator test

M300 has no moving diaphragm. This menu can be disregarded.



Switches

This menu displays one field for selection of test data.

You can choose whether the position reading of the switches shall be carried out just once or continuously (until interruption).

Press the spacer to choose between these two different alternatives.

Press F2, or the return key, to read off desired alternative.

Installation parameters

Factory-set parameters are to be found in the document "Installation Parameters".

Saving existing data

To facilitate any future exchange of the CPU board, all parameter changes shall be noted down in the above-mentioned document. Also, run the function "Save config file" after completed change.

Exchanging the firmware

Please refer to separate instructions included in the PROM kit.

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Removal

Removing the X-ray tube assembly

- Remove the swivel-arm covers, see page 2 - 2.
- Switch OFF SS and UZW.
- Remove fan, with holder (1/Fig. 1).
- Disconnect cables X897, X896, and X895 from the X-ray tube.
- Disconnect ground wires.
- Loosen the four screws (2/Fig. 1).
- Lift up the X-ray tube assembly and disconnect the high-voltage cable (1/Fig. 2).

Note: If the system is to be switched on, with X-ray tube removed, the plug X 896 H1, H2 and H3 must be jumpered.
Do not allow any contact with G.

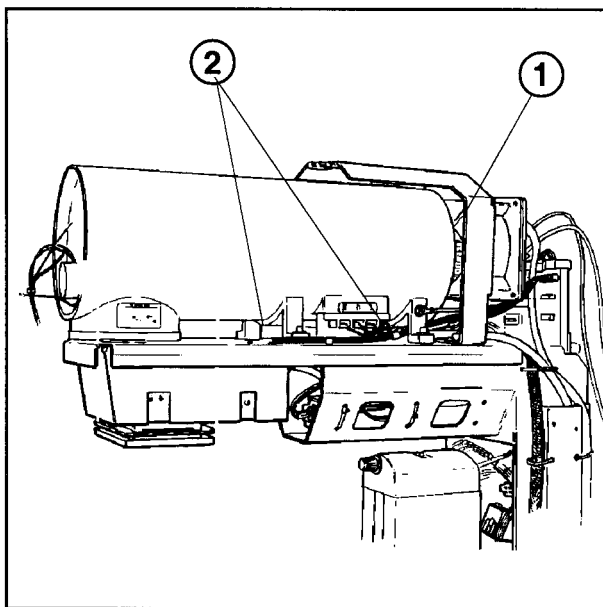


Fig. 1

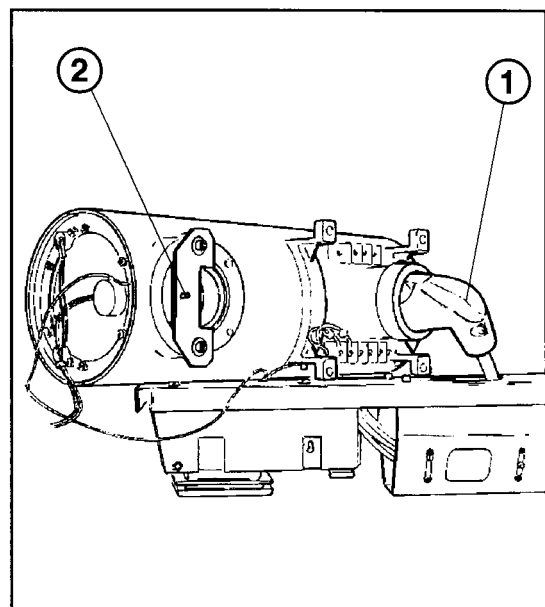


Fig. 2

Installing the X-ray tube assembly

- Connect the high-voltage cable in accordance with the rules set forth in R98-031.076.01 "Overview and regulations for high-voltage cables and cable termination".
- Mount the new X-ray tube assembly, paying attention to the guide pin (2/Fig. 2).
- Connect plugs, cables, and ground wires.

Note: *If connections H1, H2 and H3 were jumpered, remove jumpers now.*

Adjusting the bias voltage

(only if magnification table is used by the customer)

- Attach a magnification table (small focus is selected)
- Connect digital voltmeter to H3(-) and G(+).
- Adjust R9 on D20 to the voltage stated in the test certificate for the tube.

Starting up the new X-ray tube assembly

- Connect Service PC and start service program.
- Switch ON UZW and SS.
- Check that "DLF" switch is ON.
- Select "Configuration".
- Check tube type.
- Select "Learn filament" (see page 4 - 6/7) and follow the installation and start-up instructions RX B7-120.033.01... .

Type labeling, Return of LINA card

Type labeling, Return of LINA card

- Attach tube and tube housing labels (operating Instructions, page 36)
- Fill in the LINA card and return it to the address stated in the instructions on the card.

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Measuring the drift when UZW "OFF"

Preparation:

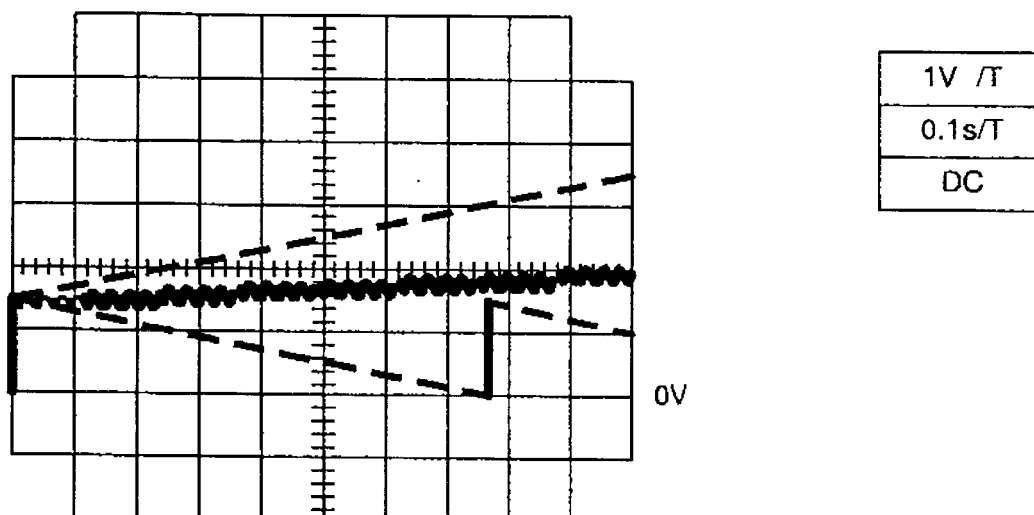
Note: Before this measurement, the generator must already be switched on for at least 5 min! Perform the following check several times.

- Set switch UZW (D702.S1) to "OFF".
- On PC board D701, remove jumper BR8 for the measurement period (Attention: Only with switched-on generator, since otherwise an error message is displayed!).
- Select IONTOMAT mode at 28 kV on the control deck.
- Connect oscilloscope to the following test points:

Signal: D701.X2.4
Ground: D701.X2.1
external trigger D705.KVE

Measurement:

After triggering an exposure on the deck, the following wave form of the drift similar to the oscillogram must result:



The thick hatched lines are the tolerance band in which the drift must be. This tolerance must be less than or equal to $\pm 1 \text{ V}/0.5 \text{ s}$.

The drift measurement refers to the integrator output of the U/F converter. With KVE and threshold voltage 0 V, the output voltage is set to +1.5 V ($\pm 0.3 \text{ V}$).

Important: Please replug jumper BR8 into D701! Wait during load time of the capacitor in the underlying control circuit (approx. 1 min.)!

Measuring the drift with UZW “ON”

Preparation:

Note: Before the measurements, the generator must be switched on for at least 5 min! Perform the following check several times.

- Generator “OFF”.
- Plug jumper on D701 X114 from 1-2 to 2-3 (dose monitoring switched off).
- Carefully cover the measuring field with lead; you can put several lead aprons one upon the other etc.
- Switch on the generator again and await until it has run up. Select IONTOMAT mode with 28 kV on the control deck.
- Set switch UZW (D702.S1) to “ON”.
- Remove jumper BR8 on D701.
- Connect oscilloscope to the following test points:

Signal: D701.X2.4
Ground: D701.X2.1
external trigger D705.KVE
- Stand must be ready for exposure, e.g. cassette loaded switch!

Measurement:

Caution: Radiation! ☢

- Trigger an exposure.
- Read off drift from oscilloscope (see previous paragraph).
- Between the exposures make a stop in order to avoid overheating of the tube assembly.
- After the end of the measurement, replug jumper BR8 and X114 on D701.

Important: After jumper BR8 has been plugged in, wait during charging time of the capacitor in the underlying control circuit (approx. 1 min).

Measuring the hum voltage

Preparation:

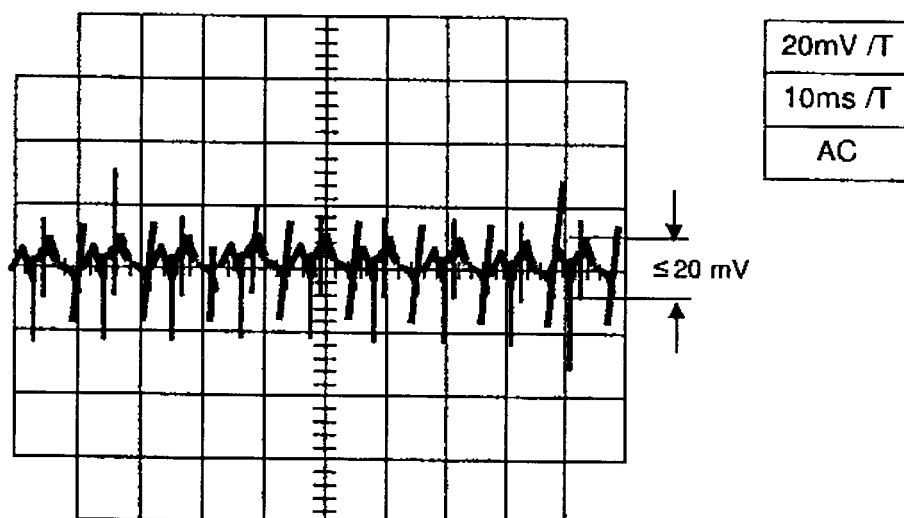
Note: Before this measurement, the generator must be switched on for at least 5 min!

- Set switch UZW (D702.S1) to "OFF".
- Select IONTOMAT mode at 28 kV on the control deck.
- Connect oscilloscope to the following test points:

Signal: D701.X2.7
Ground: D701.X2.1
external trigger D705.KVE

Measurement:

Trigger an exposure on the control deck. The following oscillogram results on the oscilloscope:



The hum voltage measured must be less than or equal to 20 mV_{pp}. The interference peaks need not be taken into account.

Possible causes for too high drift and hum voltage values**Inadmissible ground connections in the system**

- For measurement, interrupt the connection between protective ground and $0V_L$ in the generator. For this purpose, disconnect connection between X101 and X102 on D700. When checking inadmissible ground connections, also X1 must be disconnected since its shield braid is grounded to the bottom plate due to EMC requirements. Disconnect at the connector, see 7/Fig. 3, page 5-2 in the installation instructions.
- Measure the resistance between the two test points using the multimeter. The resistance measured must exceed 50 k Ω . Because of the TAZ diode between the protective ground wire and $0V_L$ in D710, repeat the measurement on the multimeter at <50 k Ω with the measuring wires interchanged.
- Re-establish the connection between both test points.

Insufficient insulation of the HSE detector

Open base plate and check insulation of the HSE detector

Interference via the IONTOMAT cable

Check whether the shielding of the IONTOMAT cables are connected correctly.

Error in IONTOMAT PM

Replace IONTOMAT PC board D701.

Adjustments and checks

If the drift and hum voltages are OK, proceed according to the flowchart below in the case of exposure fluctuations.

If density deviations occur during customer operation, check the following:

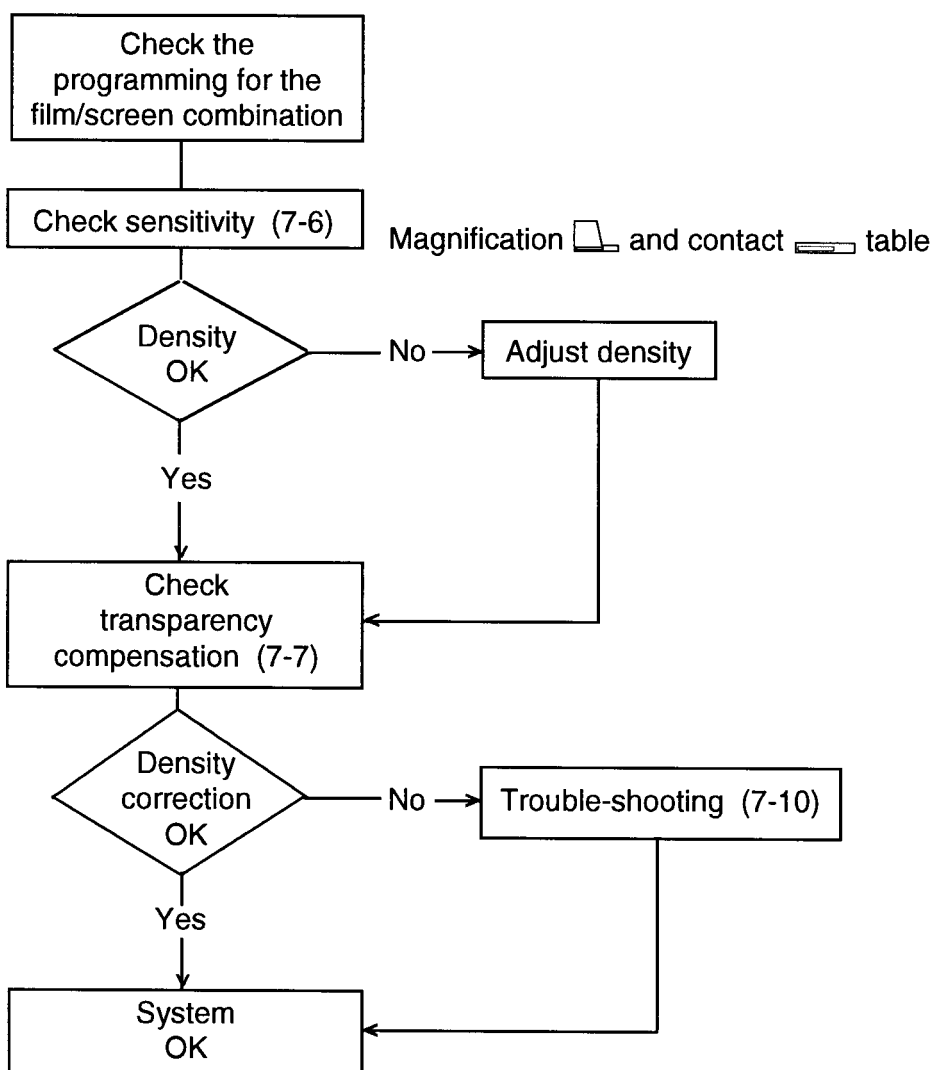
- Is the processing stable? (Check with consecutive sensitometric strips.)
- Are the cassettes of same type and in good condition? (Make test exposures with each cassette at 28 kV and 40 mm plexi and measure the density.)
- Is the connector/cable of the IONTOMAT lead properly connected?
- Operator errors, such as:

Incorrect H/D ( / ) key selected

Transparency adjustment ($\pm$ correction) not correct

Detector positioned incorrectly. The breast does not cover the detector completely (the breast must extend the detector marking on the compression plate by at least 30 mm).

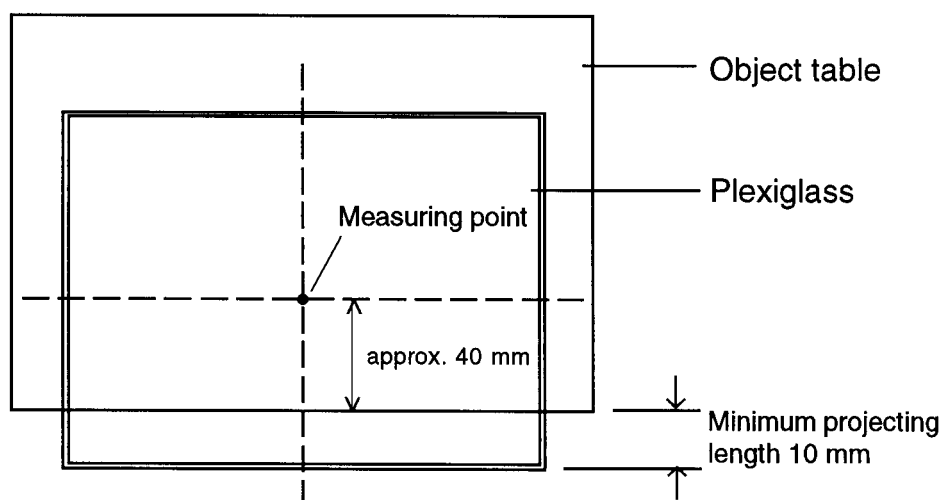
Flow chart



Checking the sensitivity

- Check the programming of IONTOMAT according to Installation and Start-Up Instructions, page 12-1 to 12-9.
- Select 25 kV on the control deck.
- Position the detector nearest to the chest-wall side and cover with 20 mm plexiglass. The plexiglass must extend at least 30 mm behind the rear edge of the detector marking on the compression plate and overlap the chest-wall edge of the table at least 10 mm.
- Make one test exposure each using:
 - Magnification table  and
 - Contact table 
- Measure the film densities in the area of the detector, using the densitometer.
- If the difference in optical density between these two films is less than 0.2 OD, proceed according to page 7-7.
- Otherwise, the density must be adjusted (see Installation and Start-Up Instructions, page 12-1 to 12-9).

Note: *Be sure to use the same type of cassette, screen and film in each object table as the customer uses.*



Note: *Detector nearest chest wall. Place the plexi plates in the same position for all exposures and measure the density as shown above on the emulsion side of the film.*

Checking the transparency compensation

Film density series with different object thicknesses

Make exposures with magnification table  and grid table  with different object thicknesses (20, 40 and 60 mm plexi). Use the kV preferred by the customer (within 25 - 35 kV).

- Detector nearest the chest-wall side
- Film density adjustment on the control deck = 0

We recommend giving each exposure a number by bending a wire or similar and placing it on the plexiglass phantom as far away from the detector as possible. With all exposures, measure the film density in the same place, see Fig. on page 7-6, and on the emulsion side of the film, using the densitometer.

Note: *The film density levels may vary from cassette to cassette. Therefore, make the film density series with the same cassette.
If the dose rate is too low, LIMIT occurs. Make a new exposure with 50 mm instead of 60 mm.*

The measured film density can be entered in the test certificates on the next page.

Test certificates**Object table:**  Grid table

Film:

Screen:

kV:

Film density adjustment: 0

Sensitivity:

No.	Plexiglass mm	Film density	mAs post- display
1	20		
2	40		
3	60		

$$\Delta D = D_{\max} - D_{\min} = \dots\dots$$

Test certificates**Object table:**  Magnification table

Film:

Screen:

kV:

Film density adjustment: 0

Sensitivity:

No.	Plexiglass mm	Film density	mAs post- display
1	20		
2	40		
3	60		

$$\Delta D = D_{\max} - D_{\min} = \dots\dots$$

Admissible tolerance of the film density values:

$$\Delta D = D_{\max} - D_{\min}$$

Grid table admissible $\Delta D_{kv} \leq 0.3$ O.D.

$D_{\max. kv}$ is the *largest film density* that is determined with constant kV and varying thickness.

$D_{\min. kv}$ is the *smallest film density* that is determined with constant kV and varying thickness.

Grid table admissible $\Delta D_{cm} \leq 0.3$ O.D.

$D_{\max. cm}$ is the *largest film density* that is determined with constant thickness and varying kV.

$D_{\min. cm}$ is the *smallest film density* that is determined with constant thickness and varying kV.

Magnification table admissible $\Delta D_{kv} \leq 0.4$ O.D.

$D_{\max. kv}$ is the *largest film density* that is determined with constant kV and varying thickness.

$D_{\min. kv}$ is the *smallest film density* that is determined with constant kV and varying thickness.

Magnification table admissible $\Delta D_{cm} \leq 0.4$ O.D.

$D_{\max. cm}$ is the *largest film density* that is determined with constant thickness and varying kV.

$D_{\min. cm}$ is the *smallest film density* that is determined with constant thickness and varying kV.

Note: *If the development of the film is very steep (gamma larger than 4), or with other cassette/film/screen combinations, see table 1 below, film density tolerances may be larger.*

The calculated film density tolerances can be entered in the test certificates above.

If ΔD is within the above mentioned tolerances, the check of the automatic exposure system is terminated. If not, please refer to "Notes on Trouble-Shooting" on the next page.

Table 1

Film	Screen	Cassette	Sensitivity	Correction curve	
				Magnification	Non-magnification
Kodak Min-RE	Kodak Min-R	Kodak Min R2	11	A1	A2
Fuji UM-MA HC	Fuji HR Mammo Fine	Fuji EC-MA	9	B1	B2
Agfa Mamoray MR6	Agfa MR Detail S	Agfa MR Details S	6.5	C1	C2
Dupont Microvision C	Dupont Quantavision ME	Dupont Quantavision	12	D1	D2

Notes on trouble-shooting

Checks with the service PC

- Generator "OFF"
- Connect service PC
- Generator "ON"
- Select menu item "normal mode" and then "IONTOMAT Data" with the service PC.

See paragraph 4 Adjustment and Service PC Programs: Generator.

Measurements

- Make exposures with 20 mm, 30 mm, 40 mm, 50 mm and 60 mm plexiglass at the kV preferred by the customer, with grid table, and the detector nearest the chest-wall side. Density adjustment on the deck = 0.
- After each exposure, read out and record:
 - the quotient (TRA/RDL) (value 1)
 - the transparency correction (value 2)
 - dose counter (RDL) (value 3)
 - transparency counter (TRA) (value 4)

The display on the screen must be updated with <CR> after each exposure.

- In addition, measure and record the film density for each exposure in the same way as in 7-6.
Use the test certificate on the next page.

Test certificate

Tube assembly:

Object table:.....

Film:

Screen:

Cassette:.....

kV:

Film density adjustment: 0

Key:  /  (H/D)

Correction curve:

Sensitivity:

Sens-Cor:

No.	Plexi mm	Film density D	mAs post- display	Quotient Q	Transp. Corr.	Dose Count	TRA Count	Sensitivity
1	20							
2	30							
3	40							
4	50							
5	60							

List of nominal quotients

25 and 35 kV, with grid

Kodak

	Plexiglass cm	2	3	4	5	6	
25 kV	Quotient	69/255	72/255	76/255	78/255	82/255	Curve: A2
35 kV	Quotient	109/255	122/255	134/255	144/255	153/255	

Fuji

	Plexiglass cm	2	3	4	5	6	
25 kV	Quotient	70/255	73/255	76/255	79/255	82/255	Curve: B2
35 kV	Quotient	108/255	120/255	135/255	143/255	153/255	

Agfa

	Plexiglass cm	2	3	4	5	6	
25 kV	Quotient	71/255	74/255	77/255	79/255	82/255	Curve: C2
35 kV	Quotient	111/255	123/255	138/255	147/255	156/255	

Dupont

	Plexiglass cm	2	3	4	5	6	
25 kV	Quotient	68/255	71/255	74/255	77/255	80/255	Curve: D2
35 kV	Quotient	103/255	115/255	127/255	139/255	148/255	

There might be an offset in quotient (all values are decreased or increased by the same value) due to differences in detectors and plexiglasses.

Evaluation of the values measured for transparency compensation

1st possibility:

Diagnosis:

- Quotient outside the tolerance (compare with "List of nominal quotients", page 7-12)
- TRA-Count very small or zero
- TRANSP-Corr. is always zero

Example:

RDL-Count= 3160

TRA-Count= 0

Quotient = 000/255

TRA-Corr = 0

Measures:

- With the oscilloscope, check the TRA signal (X041E, 5 - 10)

2nd possibility

Diagnosis:

- Quotient outside the tolerance
- RDL-Count very small (smaller than TRA-Count) or zero
- TRANSP-Corr. always maximum

Example:

RDL-Count= 64

TRA-Count= 1059

Quotient = 254/255

TRA-Corr = 32/8

Measures:

- With the oscilloscope, check the RDL signal (X041E, 5-10)

3rd possibility:

Diagnosis:

- Quotient is within the tolerance. Nevertheless, the measured film density values are outside the tolerance.
Possible cause: See below.

Checking the developing process and film/screen combination used

- The developing process is not stable.
Make a sensitometric strip test every 15 minutes with film from the same batch. Make sure that the emulsion side of the film faces the exposure device of the sensitometer. Measure the optical density of the sensitometric strip on the emulsion side, using the densitometer. Check which step is nearest in film density to the density used by the customer. Compare the density of this step with the density of the corresponding step on all other strips. If the density differs more than ± 0.05 O.D., the developing process is not stable.
- A screen or film/screen combination not listed in table 1 on page 7-9 is used.
Try other correction curves, see page 12-3 in Installation and Start-Up Instructions.
- The development of the film is too steep (the film gamma is too high). In order to determine this, a sensitometry must be carried out.
Make a sensitometric strip test.

Evaluation of the sensitometry:

Determine the two sensitometric strip values, S_1 and S_2 , that are nearest above and below the density used by the customer. Calculate the film gamma, using the formula below:

Example: Customer uses a density of 1.50

$$\text{gamma} = \frac{S_1 - S_2}{0.15}$$

Step 12	2.39 OD
Step 11	1.93 OD
Step 10	1.23 OD

$$S_1 = 1.93 \quad S_2 = 1.23 \quad \text{gamma} = \frac{1.93 - 1.23}{0.15} = 4.67$$

The tolerances of the AEC are specified for gamma = 4.0. If the customer uses a gamma that exceeds 4.0, the measured ΔD can be converted to the corresponding value at gamma = 4.0, using the formula:

$$\Delta D_{\gamma=4} = \Delta D \cdot \frac{\text{gamma}}{4}$$

Checking the kV trimming

- System OFF.

Warning!

After shut-down of the system, there may still be about 380 V d.c. present on the intermediate circuit. This will be indicated by LED V24 on p.c. board D710. The voltage will drop to less than 30 V within about 3 minutes; the LED goes out at about 30 V.

IONTOMAT PM

- Connect DVM between the lower ends of R72 and R73 (on the left side of the high tension plug) on D710 circuit board.
- System ON.
- Set 25 kV and maximum mAs on the control console. Check that DVM shows $\pm 2.5V \pm 0.010$, otherwise adjust R43 on D702.

Checking the detector cable

- Check that the cable to the detector is not damaged, that all sockets are properly locked in the connector (X864) housing and that its plug is fully inserted in the detector.
- Check connectors X869, pins 13 to 18, and X870, which are connected to D805 (see page 3 - 7). See wiring diagram 3 - 9 for location of connectors.

Checking the D701 trimming

- Connect cable 63 82 746 between X11 from stand and X11 on D700.
- Connect service PC.
- Select Sensitivity 11 (see page 4 - 2)
 Sens. corr 0 (see page 4 - 3)
 TCR on (see page 4 - 14)
 Speed H A2 (see page 4 - 4)
- Select normal mode, IONTOMAT Data (see page 4 - 25).
- On the control console, select AEC mode for contact exposure, 27 kV and set film density to +2.0.
- Use a grid table and place a cassette without film into the table. Place 30 mm plexi on the table. Let the system be warmed up for at least 5 minutes before measuring.
- Make the exposure and check that the TRA counter is equal to RDL within ± 5 . If not, adjust R230 on D701. The counter shall show between 5500 and 6500.

Caution! Do not overload the X-ray tube.

Replacing the detector and/or D701

- See page 2 - 3 for replacing the detector.
- Should the tolerance still be too large, then D701 is probably defective and must be replaced.

4rd possibility

Diagnosis:

- Quotient only a little outside the tolerance.
- For RDL-Count and TRA-Count, valid values are determined.

Drift measurement

See pages 7 - 1 and 7 - 2.

Measuring the actual value of the intermediate circuit voltage

Preparation:

- Set switches UZW (D702.S1) and SS (D702.SS) to "ON".
- Connect an oscilloscope to the following test points:

Channel 1:	D705.X713	UZist	$1\text{ V} \hat{=} 50\text{ V}$
Channel 2:	D705.X711	kVist	$1\text{ V} \hat{=} 5\text{ kV}$
Trigger:	D705.X714	KVE	

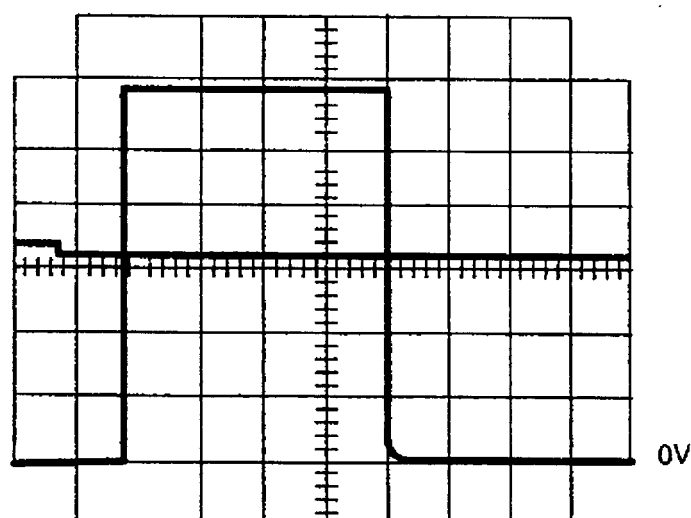
NOTE! The kVist is also measured with the oscilloscope in order to detect when the high-voltage starts.

- On the deck, select a small mAs value, e.g. 32 mAs, and set the desired kV value, e.g. 28 kV.

Caution: Radiation ☸

Measurement:

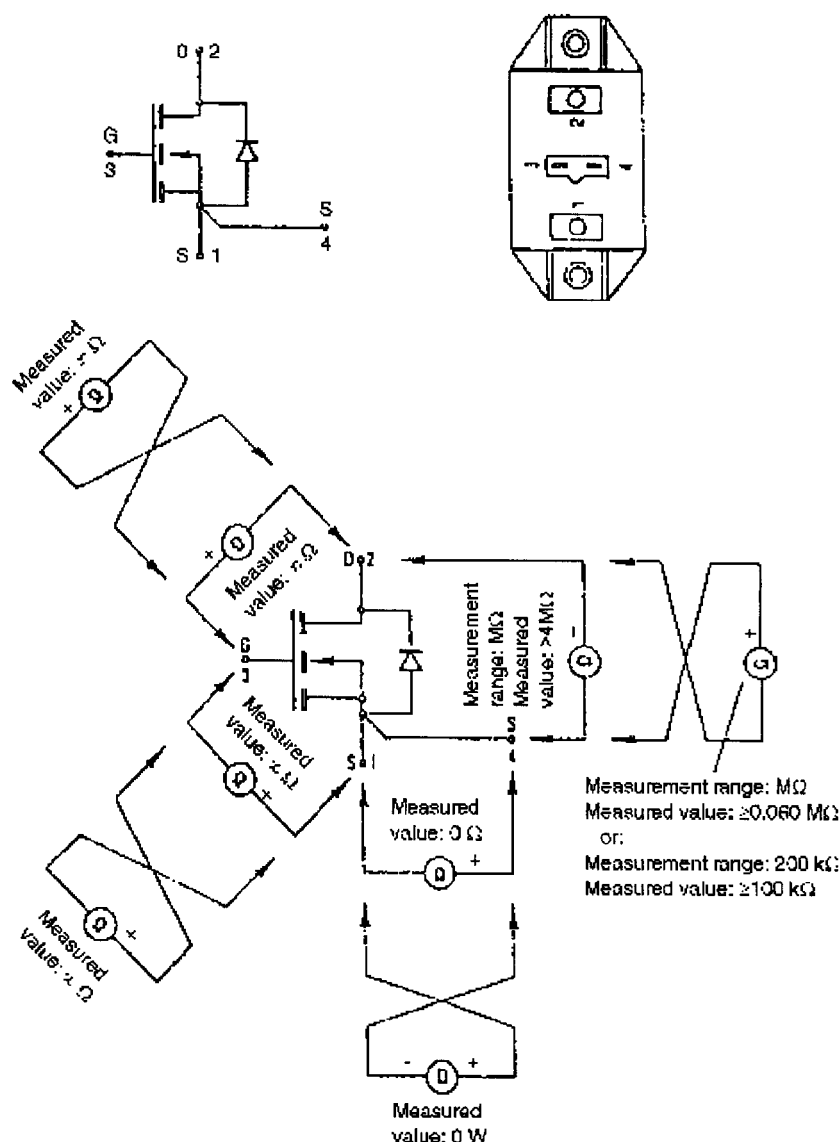
After triggering the exposure on the deck, the following oscillogram results:



Chan. 1 2V/T
Chan. 2 1V/T
50 ms/T
DC

In the example: Measured values for the P49Mo 03 tube with 28 kV and large focus.

- Attention:** Never touch G (3) first! Danger of damage!



Carry out this measurement first!

- Replace the transistor
- Check control according to 7-13 (Power-MOSFET).

Power-MOSFET control in start up mode**Preparation:**

- Set switch UZW (D702.S1) to "OFF" and wait approx. 3 minutes!
- Set switch SS(D702.S2) to "OFF".
- Connect an oscilloscope to the following test points:

For V1: D710.V157 (Anode) to G (Conn. 3)

For V2: D710.V151 (Anode) to G (Conn. 3)

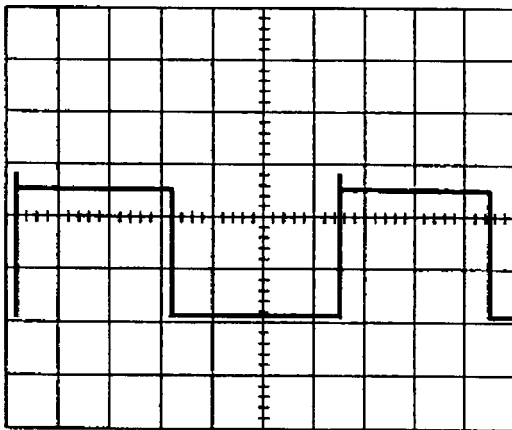
For V3: D710.V153 (Anode) to G (Conn. 3)

For V4: D710.V155 (Anode) to G (Conn. 3)

Trigger: D705.X716 ZBL

Measurement:

With the release button, start a rotating anode start-up.

**Oscillogram 1:**

5 V/T

1ms/T

DC

NOTE! If the oscillogram deviates from the display, PC Board D710 must be replaced.

The transistor control frequency for the rotating anode start-up can be adjusted with potentiometer R136 on D702 (160 Hz +/- 2%).

Power-MOSFET control in exposure mode

Preparation:

- Set switch UZW (D702.S1) to "OFF" and wait approx. 3 minutes!
- Set switch SS(D702.S2) to "ON".
- Connect an oscilloscope to the following test points:

For V1: D710.V157 (Anode) to G (Conn. 3)

For V2: D710.V151 (Anode) to G (Conn. 3)

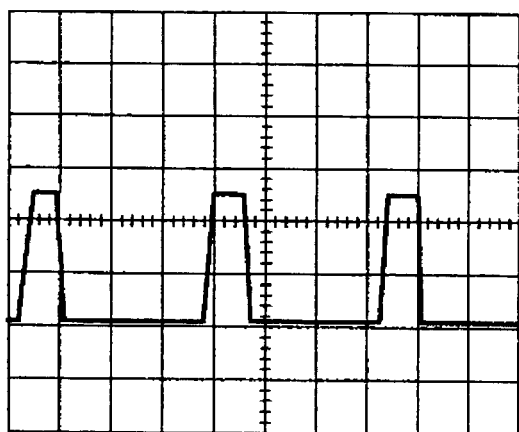
For V3: D710.V153 (Anode) to G (Conn. 3)

For V4: D710.V155 (Anode) to G (Conn. 3)

Trigger: D705.X714.KVE

Measurement:

With the release button, trigger one exposure.



Oscillogram 2:

5 V/T

10 μ s/T

DC

It must be possible to read off a periodic time of approx. 35 μ s from the oscilloscope. This corresponds to a transistor control frequency of approx. 30 kHz.

NOTE! If the oscillogram deviates from the display, PC Board D710 must be replaced.

Measuring the oscillating current with rotating anode start-up

- Set switch UZW to "ON".
- Set switch SS to "OFF".
- Connect an oscilloscope to the following test points:

Signal: D705.X710 I_{Schwing}
0 VA: D705.X708
Trigger: D705.X716 ZBL
- With the exposure release button, start a rotating anode start-up.
Oscillogram according to wiring diagram X041A, 5 - 8.

Measuring the oscillating current during exposure

Caution! Radiation! ☸

- Set switch UZW to "ON".
- Set switch SS to "ON".
- Connect the oscilloscope to the following test points:
Signal: D705.X710 I_{Schwing}
0 VA: D705.X708
Trigger: D705.X716 KVE
- Select a small mAs value at 28 kV.
- Trigger one exposure with the release button.
Oscillogram according to wiring diagram X041E, 5 - 8.

Measuring the oscillating current during braking

- Generator "OFF" Set switch UZW to "ON".
- Set switch SS to "OFF".
- Connect the oscilloscope to the following test points:
Signal: D705.X710 I_{Schwing}
0 V: D705.X708
Trigger: D705.X984 BS
- With the generator "ON", the oscillogram must be measured according to wiring diagram X041E, 5 - 8.

Check and adjust the kV nominal value

Preparation

- Connect a digital voltmeter to test point D705.kVsoll ($1\text{ V} \triangleq 5\text{ kV}$) and X708 (0VA).
- Generator "ON".
- The kV value can be increased or decreased by actuating the kV keys.
- An adjustment can be made with potentiometer R43 on board D702.
- Remove the digital voltmeter.

Display test

A separate test switch (D740.S23) is intended for the display test in the generator.

- Remove the front panelling of the generator and the plate under the desk board
- Briefly actuate the test switch (D740.S23)

All displays light up for 10 seconds and then one at a time (running light).

Afterwards, 10 is displayed on the kV display. This is counted down to 01, together with a "ticking". The stored error numbers are displayed afterwards.

At the end of a read-out, Er 000 is displayed and a beep sounds.

The test is ended and the default data are indicated on the control deck.

- Reinstall the plate and front panelling.

Control deck

Erase the EEPROM (D740.J 12) and recording the default data

- Remove the front panelling of the generator and the plate under the desk board

Preparation:

Before starting this procedure, read out and record the old adjustment data with the service PC, if necessary.

Implementation:

Operation as follows:

- Shortly actuate the test switch (D740.S23). Wait until the display test is terminated (see page 7 - 28).

10 appears on the kV display. This is counted down to 01 second-by second, together with a "ticking".
- Switch off the generator during this counting procedure; the deletion procedure is thus prepared.

NOTE! *If you do not switch off within this time, the error numbers stored are displayed and no deletion is made.*

- Withdraw D702 in order to close down the master - deck communications.
- Generator "ON".

On the control deck, the display "busy" appears.

It is essential to wait 2 minutes!

Afterwards, all old data are deleted.

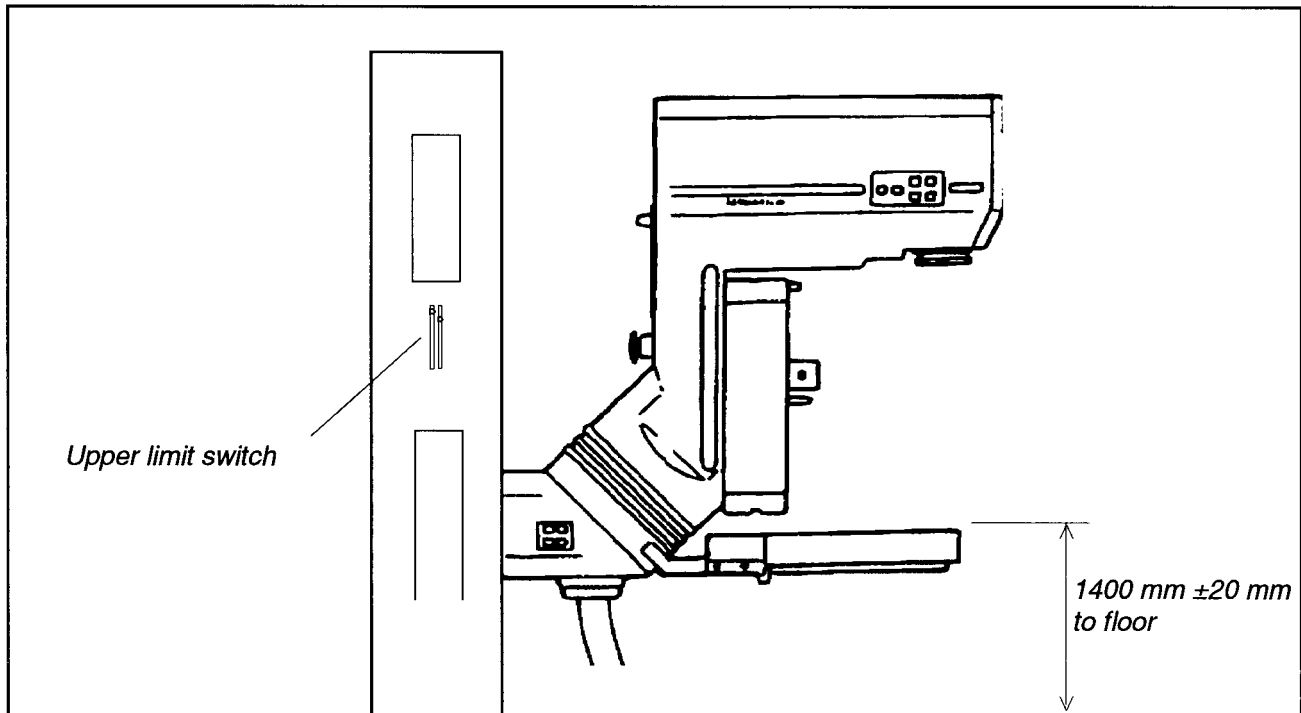
- Generator "OFF".
- Reinsert D702.
- Generator "ON".
- Reprogram the panel with the installation parameters and any noted adjustment data and finish the adjustment correctly.
- Reinstall the plate and front panelling.

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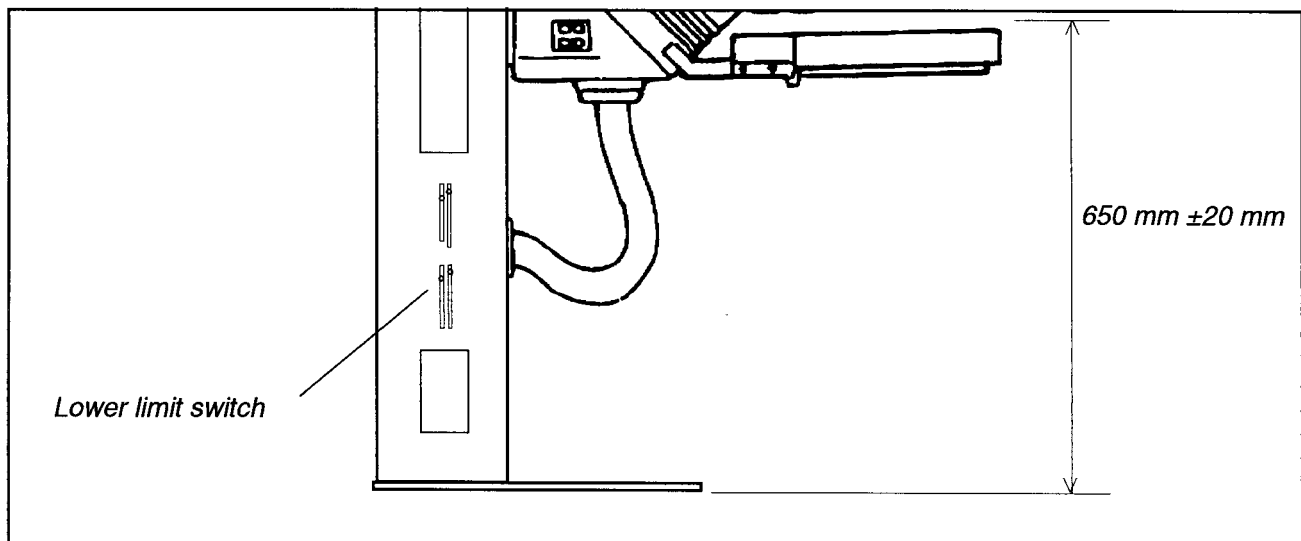
Vertical movement

Checking/adjusting the vertical movement of the lift carriage

For adjustment of the limit switches, remove left side cover, see page 2 - 1.



Upper limit Fig. 1



Lower limit Fig. 2

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Adjusting the radiation field to the image receptor

- It is possible to adjust the radiation field to the image receptor by loosening the screws (1/Fig. 3) on both sides and then displacing the complete assembly. See also chapter "Checking the radiation field limitation" in the Installation and Start-Up Instructions for MAMMOMAT 300.

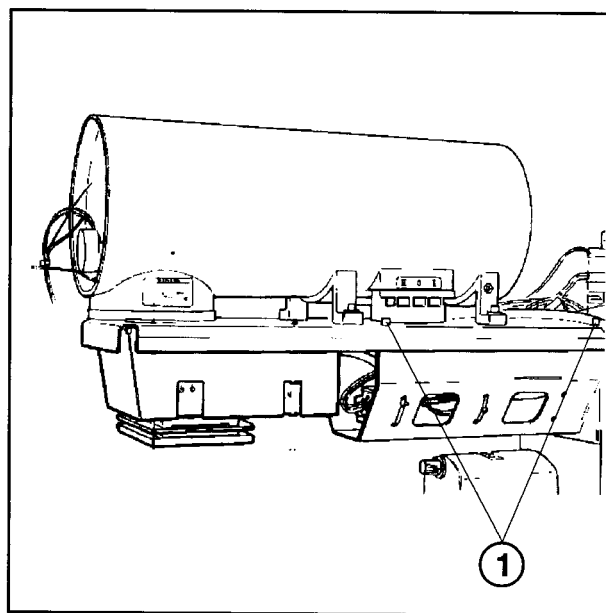


Fig. 3

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List of error messages

Error messages of the master Er 0XX

Er 001

"Communication master - control deck faulty"

Displayed on PC: Communication master < - > deck disturbed
or deck not ready

Er 004

"Communication master - IONTOMAT PM faulty"

Displayed on PC: Communication master < - > IONTOMAT disturbed
or IONTOMAT not ready

Er 005

"E²PROM in IONTOMAT PM defective or not programmed"

Displayed on PC: EEPROM in IONTOMAT is defective or not
programmed

Er 006

"Power pack not ready for exposure"

Displayed on PC: Power section not ready

Er 008

"Stand not ready"

Displayed on PC: Communication master < - > stand disturbed
stand not ready

Er 010

"Data collision; exposure blocked"

Displayed on PC: Communication failure master < - > deck

Er 012

"Time limit reached"

Displayed on PC: Time limit reached

Er 013

"Limit mAs during IONTOMAT exposure"

Displayed on PC: mAs limit reached in IONTOMAT exposure

Er 015

"Master error during exposure"

Displayed on PC: Processor failure during exposure

Er 016

"mAs post display larger than 999 mAs"

Displayed on PC: Exposure post indication >999 mAs

Error messages of the control deck Er 1XX**Er 102****"Deck in STAND ALONE mode on exposure release"***Displayed on PC:* No communication deck < - > master**Er 103****"Exposure has been stopped"***Displayed on PC:* Exposure aborted by user**Er 105****"Incorrect check sum in the E²PROM"***Displayed on PC:* Checksum error in configuration data
stored in deck EEPROM**Er 106****"E²PROM cannot be checked"***Displayed on PC:* Deck EEPROM writing failed**Error messages of the control deck Er 3XX****Er 301****"I_{Hmin} during initialization"***Displayed on PC:* I_{Hmin} filament current too low at
initialization**Er 302****"Filament current monitoring I_{Hmin} has responded"***Displayed on PC:* I_{Hmin} filament current too low at standby**Error messages of the IONTOMAT PM Er 5XX****Er 513****"Programmed detector not admissible"***Displayed on PC:* Programmed detector not valid**Er 515****"Programmed plug position not admissible"***Displayed on PC:* programmed sensitivity not valid**Er 523****"Ports or timer on D701 defective"***Displayed on PC:* Ports or timer on D701 defective**Er 524****"BR8 on D701 missing"***Displayed on PC:* Jumper BR8 missing, or defective
analog input on D701

Er 525

"Interrupt inputs on the D701 defective"

Displayed on PC: Interrupt inputs on D701 defective

Er 550

"Dose monitoring has responded"

Displayed on PC: Exposures aborted by dose monitoring

Error messages of the power pack Er 6XX

Er 601

"Rotation not reached"

Displayed on PC: Rotation speed not reached in 3 s

Er 602

"Tube voltage <17 kV"

Displayed on PC: kV_{min}-minimum tube voltage 17 kV
not reached

Er 603

"Tube voltage > 50 kV"

Displayed on PC: kV_{max}-tube voltage greater than 50 kV

Er 604

"WR blank is applied"

Displayed on PC: WR-AUSTAST - inverter short circuit
blanking signal remains

Er 605

"Module current too high during rotary anode acceleration"

Displayed on PC: Inverter short circuit during
anode rotation boost

Er 606

"Module current too high during exposure"

Displayed on PC: Inverter short circuit during
rotation

Er 607

"Module current too high during braking"

Displayed on PC: Inverter short circuit during
brake cycle

Er 608

"No CNT pulses"

Displayed on PC: No CNT pulses during anode
rotation boost

Er 609**"U_{Zmin} intermediate circuit voltage < 180 V"**

Displayed on PC: U_{Zmin}-intermediate circuit voltage
too low

Er 610**"KVA is missing during start-up of the rotating anode"**

Displayed on PC: KVA signal disabled during rotating anode
boost

Er 611**"KVA is missing during exposure"**

Displayed on PC: KVA signal disabled during rotation

Er 612**"KVA is missing during braking"**

Displayed on PC: KVA signal disabled in braking mode

Er 613**"Pressure switch PH1 or OKT2 has responded"**

Displayed on PC: Exposure aborted by pressure switch
or beam form anode or dorr switch

Er 620**"UCTRL is missing"**

Displayed on PC: U_{anst} + 15V to control inverter
not present

Er 630**"Pressure switch PH1 has responded"**

Displayed on PC: Pressure switch on the HV tank
activated

Error messages of the stand Er 8XX**Er 801****"AR is not released"**

Displayed on PC: Time out of AR signal

Er 802**"OKT 2 has responded"**

Displayed on PC: OKT pressure switch on tube housing
or beam form anode or door switch

Er 803

"OKT 1 has responded"

Displayed on PC: OKT 1 temperature switch on tube housing activated

Er 811

"Stand not ready for exposure"

Displayed on PC: Stand not ready for exposure

Er 812

"Compression Protect Error"

Displayed on PC: Compression protect switch not OK in stand

Er 813

"Compression OK Error"

Displayed on PC: Motor controller board or motor error

Er 815

"Compression Speed Error"

Displayed on PC: Compression speed too high, error suspected, in stand

Er 819

"Drive Protect Error"

Displayed on PC: Drive protect switch not OK (lift and rotation) in stand

Er 820

"EEPROM Write Error"

Displayed on PC: Write/read back failure with EEPROM in stand

Er 821

"EEPROM Version Error"

Displayed on PC: Stand EEPROM has wrong version number

Er 822

"Grid Run Error"

Displayed on PC: Grid failed to move properly

Er 824

"Motor Voltage Error"

Displayed on PC: Stand motor voltage drops unnaturally

Er 825

"Pot Missing Error"

Displayed on PC: One or more potentiometers seems to have lost contact with the stand

Er 826**"Pot Short Circuit"**

Displayed on PC: There is short circuit somewhere among potentiometers

Er 850**"Incorrect checksum for stand installation menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for stand installation menu,
i.e. table 1 in the stand EEPROM

Er 851**"Incorrect checksum for calibrate compression menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for calibrate compression menu,
i.e. table 2 in the stand EEPROM

Er 852**"Incorrect checksum for rotation calibration menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for rotation calibration menu,
i.e. table 3 in the stand EEPROM

Er 853**"Incorrect checksum for rotation calibration menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for rotation calibration menu,
i.e. table 4 in the stand EEPROM

Er 854**"Incorrect checksum for lift parameters menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for lift parameters menu,
i.e. table 4 in the stand EEPROM

Er 855**"Incorrect checksum for best compression menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for lift parameters menu,
i.e. table 6 in the stand EEPROM

Er 856**"Incorrect checksum for rotation parameters menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for rotation parameters menu,
i.e. table 7 in the stand EEPROM

Er 857**"Incorrect checksum for rotation parameters menu in stand EEPROM"**

Displayed on PC: Incorrect checksum for rotation parameters menu,
i.e. table 8 in the stand EEPROM

